STUDY OF COGNITIVE FUNCTION AND RECOVERY AFTER LOW FLOW SEVOFLURANE ANESTHESIA IN PATIENTS UNDERGOING ELECTIVE LAPAROSCOPIC CHOLECYSTECTOMY SURGERIES

A COMPARISON OF LOW-FLOW AND MEDIUM-FLOW ANESTHESIA - A STUDY OF 60 CASES

DISSERTATION SUBMITTED FOR

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BRANCH X (ANAESTHESIOLOGY)

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This is to certify that this dissertation entitled **"STUDY OF COGNITIVE FUNCTION AND RECOVERY AFTER LOW FLOW SEVOFLURANE ANAESTHESIA IN PATIENTS UNDERGOING ELECTIVE CHOLECYSTECTOMY SURGERIES : A COMPARISION BETWEEN LOW FLOW AND MEDIUM FLOW ANAESTHESIA"** submitted by **DR.R.ARUN** to the FACULTY OF ANAESTHESIOLOGY, THE TAMIL NADU DR. M.G.R MEDICAL UNIVERSITY, CHENNAI, in partial fulfillment of the requirement in the award of the degree of M.D., degree Branch X (ANAESTHESIOLOGY) for the **April 2015** examination is a bonafide research work carried out by him under my direct supervision and guidance.

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I, **DR.R.ARUN** declare that the dissertation titled **"STUDY OF COGNITIVE FUNCTION AND RECOVERY AFTER LOW FLOW SEVOFLURANE ANAESTHESIA IN PATIENTS UNDERGOING ELECTIVE CHOLECYSTECTOMY SURGERIES : A COMPARISION BETWEEN LOW FLOW AND MEDIUM FLOW ANAESTHESIA"** has been prepared by me. This is submitted to the Tamil Nadu Dr. M.G.R Medical University, Chennai, in partial fulfillment of the requirement for the award of M.D. Degree Branch X (Anaesthesiology) Degree Examination to be held in April 2015. I also declare that this dissertation, in part or full was not submitted by me or any other to any other university or board, either in India or abroad for any award, degree or diploma.

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CONTENTS

STUDY OF COGNITIVE FUNCTION AND RECOVERY AFTER LOW FLOW SEVOFLURANE ANESTHESIA IN PATIENTS UNDERGOING ELECTIVE LAPAROSCOPIC CHOLECYSTECTOMY SURGERIES A COMPARISON OF LOW-FLOW AND MEDIUM-FLOW ANESTHESIA - A STUDY OF 60 CASES

ABSTRACT

AIM:

The aim of the study is to compare the effects of medium flow and low flow sevoflurane anaesthesia on post operative cognitive function and recovery in patients undergoing elective laparoscopic cholecystectomy surgeries.

MATERIALS AND METHODS:

60 ASA 1 and 2 patients aged 25 to 60 years undergoing elective laparoscopic cholecystectomy surgeries were selected. They were randomly divided into two groups low flow group and medium flow group. The general anaesthesia was standardized for two groups. During maintenance the fresh gas flow was set to 1l/min in low flow group and 4l/min in medium flow group. The sevoflurane concentration was set to 2%. The MMSE score, VAS score and Ramsay sedation score recorded preoperatively, at 1hr,3hrs, 6hrs and 24hrs post operatively.

RESULTS

There were no significant differences in recovery times or MMSE scores between the groups. 4 (13.3%) patients in the low flow group and 3 (10%) patients in the medium flow group had decrease in the 1st hr MMSE score more than 2 when compared to baseline score which was defined as cognitive dysfunction. Emergence recovery criteria (ie) the time taken to open eyes, squeeze fingers, extubation, recalling name and the time taken for aldrete score >9 also had no

significant difference between the low flow and the medium flow group. The fresh gas flow have no effect over the post operative cognitive function and recovery.

DISCUSSION:

The effect of sevoflurane on post operative cognitive dysfunction is not clear. the production of compound A have led to the controversies in the safety of low flow sevoflurane anaesthesia. The effect of low flow sevoflurane anaesthesia on recovery and post operative cognitive dysfunction is not clear. The MMSE score was used to determine the cognitive function. The reduction in the score >2 post operatively was the criteria to determine cognitive dysfunction. Our study did not find a significant difference in recovery and post operative cognitive dysfunction.

CONCLUSION

We conclude that the fresh gas flow have no effect on the post operative cognitive function and recovery times in patients undergoing sevoflurane anaesthesia for elective laparoscopic cholecystectomy surgeries.

KEYWORDS :

SEVOFLURANE, MMSE SCORE, GENERAL ANAESTHESIA

INTRODUCTION

The aim of general anaesthesia is to provide analgesia, hypnosis, immobility, blunting autonomic responses. They are induced by general anaesthetics by their specific interactions on discrete neural loci. It was believed initially that the effects of the drugs on various systems won't outlast the duration of action of drugs. Reversible changes in brain function occurs immediately after general anaesthesia which may be characterized by drowsiness, decreased attention to oral commands, memory, and increased reaction time to oral commands. Cognition may be defined as the mental processes of perception, memory and processing the information , which allows a person to acquire knowledge, solve problems and plan for the future. Postoperative disturbance in cognition is referred as postoperative cognitive dysfunction (POCD). The return of an individual cognitive capacity is dependent on factors like type of surgery and anaesthesia, duration of anaesthesia, prior presence of any respiratory complications and repeated operations.

The concept of day care surgeries have gained popularity due to decreased hospital costs, lower risk of hospital acquired infections, increased availability of beds, more efficient utilization of resources, quicker return of the patients to

social life. The general anaesthesia for ambulatory surgeries requires the optimal surgical conditions to be achieved and at the same time patient should have earlier recovery. To this the agents used should have short duration of action and has to be eliminated without any residual effects. Laparoscopic surgeries aim at quick discharge of the patients. The anaesthesia for these surgeries requires the use of agents that are short acting and should have faster recovery.

Volatile anaesthetics to be used in these surgeries should be eliminated soon from the body with minimal metabolic break down. This follows that the agents having low solubility or low blood gas partition coefficients can be used for these procedures without much delay in recovery of cognitive function. Among the volatile agents in recent use sevoflurane and desflurane have low blood gas partition coefficients (0.65 and 0.42 respectively) and can be used for these surgeries.

Sevoflurane is a more commonly used inhalational agent that has low solubility and results in rapid induction and rapid recovery. Sevoflurane (1-trifluoromethyl-2,2,2-trifluoroethyl monofluoromethyl ether) was first synthesized in the 1970s, but was introduced in clinical use only in 1981 due to reports of renal toxicity in experimental animals.

The low flow anaesthesia was developed mainly for economic use of gases and to reduce the pollution of theatrical atmosphere by the anaesthetic gases. Sevoflurane use in the low flow system is more controversial due to the formation of compound-A which was reported to be nephrotoxic in animal studies. However the nephrotoxicity of the byproduct have not yet been proved in humans. The degradation products of sevoflurane and its relation to organ damage when it is used in low flow anaesthesia was studied by Frink et al. The effect of sevoflurane anesthesia with low fresh gas flow on postoperative cognitive dysfunction (POCD) and the emergence is still unclear.

Hence this study was carried out to get an insight into the effect of sevoflurane used in low flow anaesthesia on post operative cognitive dysfunction and recovery in patients undergoing elective laparoscopic cholecystectomy surgeries under general anaesthesia.

AIM OF STUDY

The aim of this randomized, prospective study is to compare the effect of sevoflurane when used in low flow anesthesia and medium flow anaesthesia on cognitive function and recovery in patients undergoing elective laparoscopic cholecystectomy under general anesthesia.

HISTORY OF INHALATIONAL ANAESTHESIA

The history of inhalational anaesthetic agents date back to the dawn of anaesthesia. Humprey davy first observed the analgesic effects of nitrous oxide as back as 1800 and named it as laughing gas. Horace wells in 1844 described the use of nitrous oxide to facilitate the extraction of tooth.

Henry Hill Hickman, in 1824 demonstrated that anaesthesia could be induced and surgical procedures could be carried out using carbon di oxide. He was the one who introduced the concept of anaesthesia using an inhaled substance. The first recorded general anaesthetic administered in humans was in 1842, when both C W LONG and W CLARKE successfully induced anaesthesia using diethyl ether.

In 1846 W T G MORTAN first used ether in USA in his demonstration in public in 1846 on 16th October at Massachusetts general hospital. Ether was commonly used agent for many years because it can readily produced in pure form, is a potent volatile liquid - only a few volumes percent required for adequate depth of anaesthesia and also hypoxia can be avoided and also had no major effects on respiration and circulation

Chloroform was then first used by James Simpson in 1847. Its use spread quickly and it was used by John Snow for giving labour analgesia to Queen

Victoria during the birth of Prince Leopold. It had properties of pleasant odour and non flammability, but the major problems associated with its use were severe cardiovascular depression and hepatotoxicity.

These two agents along with nitrous oxide remained the mainstays for the next 80 years until when cyclopropane discovered by Lucas and Henderson and remained popular for a long time, however its use decreased due to its flammable nature.

In 1932 Booth and Bixby observed that the greatest potential for non-combustible anaesthetic agents lay with organic fluoride compounds because the replacement of fluoride for other halogens causes a reduction in boiling point, increases the stability, and reduces the toxicity of gases. Fluroxene, the first fluorine containing anaesthetic agent introduced in 1950.

Modern inhalational agents, first of its kind was halothane synthesized by C W Suckling in 1951and introduced into clinical practice by Michael Johnstone in Manchester in 1956. Enflurane produced by R C Torrel of Ohio medical products in 1966. Isoflurane structural isomer of enflurane was first produced in 1968 by DR R C Terrel.

Sevoflurane was first synthetized in the late 1960s at Baxter Travenol laboratories by R F Wallin and co workers. The first recorded use in humans was in 1981.

Desflurane was first produced by Dr Ross Terrel and approved for clinical use in 1992.

SHORT HISTORY OF LOW FLOW ANAESTHESIA

John Snow in 1850 was the first in using the rebreathing technique when he found that the expired anaesthetic vapours were unchanged and this can be used for prolongation of narcotic effects when recirculated in closed circuit after elimination of carbon di oxide.

Jackson, Coleman, Gauss, Waters, Sudeck, Schmidt, and Drager were the pioneers in the use of rebreathing systems with carbon dioxide absorption. The uses of this anaesthetic technique were detailed by Ralph Waters in 1924.

The use of low flow technique decreased with the use of trichloroethylene which were incompatible with sodalime and the use of halothane. The vaporisers used were poorly compatible with low flow and had problems in monitoring fresh gas flows and the inspired anaesthetic concentration. As a results high fresh gas flows were increasingly used as the monitoring the anaesthetic concentration delivered was easy.

However interest in low flow anaesthesia has been increased with the introduction of agents like desflurane and sevoflurane which are most suited for rebreathing techniques

UPTAKE, DISTRIBUTION AND ELIMINATION OF INHALATION AGENTS

The anaesthetic depth is directly proportional to the brain concentration of the agent used which is in equilibrium with the arterial blood concentration which is in par with alveolar concentration of the agent. So the alveolar concentration represents the brain concentration indirectly. The following factors influence the alveolar concentration and thus the brain concentration.

TRANSFER FROM INSPIRED AIR TO ALVEOLI

THE CONCENTRATION OF GAS INSPIRED:

According to the law of partial pressures by Dalton, the tension of any single gas in the air inspired is equal to the atmospheric pressure times the fraction of the inspired gas. The greater inspired air the faster would be the approach of FA to FI. This may also be modified by concentration effect and second gas effect. During maintenance, FI may be more than FA depending on the solubility of the agent.

ALVEOLAR VENTILATION:

Some anaesthetic is delivered to the alveoli at each breath and if this is unopposed by uptake the ratio of FA to FI increase to 98% in two minutes. The

rate of rise of FA/FI is dependent on FRC and minute ventilation. The greater the functional residual capacity causes slower rate of rise in FA. The alveolar tension varies directly with the minute volume (ie) the lung wash out. The effects of minute ventilation are transient for poorly soluble gases like N2O and desflurane whereas it has greater effect on uptake of highly soluble compounds.

ANAESTHETIC CIRCUIT:

FI would equal the concentration of agent delivered by the machine (FM) when a non rebreathing circuit is used. This depends on the wash in characters of external breathing system, the total fresh gas flow and the circuit volume . The concentration delivered by the machine will be greater than the alveolar concentration even after 60 min when a low flow of 1l/min is used.

INSPIRED ALVEOLI TO THE ARTERIAL BLOOD TRANSFER

The alveolar membrane don't interfere in movement of inhalation agents in both direction. However the increase in shunt flow will reduce the flow rate into the blood especially for poorly soluble inhalational agents. In the absence of shunt the speed of uptake

$$Qgas = t\ B{:}G \times \text{cardiac output} \times P\ A\text{-}Vgas/Patm$$

If any of the three factors becomes 0 then uptake becomes 0.

Lower blood gas coefficient are seen with hemodilution, obesity, hypoalbuminemia and starvation. Higher is seen with adults ,hypothermia and postprandially. The more soluble compound have a larger blood reservoir, while it is low for less soluble agents and fills in quickly. This forms the important factor affecting the approach of FA to FI.

ANAESTHETIC AGENT	BLOOD- GAS CO-EFFICIENT AT 37˚C
HALOTHANE	2.4
ISOFLURANE	1.4
SEVOFLURANE	0.69
DESFLURANE	0.42
NITROUS OXIDE	0.47

CARDIAC OUTPUT

An increase in cardiac output will cause a decrease in the initial part of the arterial tension of the agent to the time curve by slowing down the approach of FA to FI by increasing the uptake. The vice versa is true with low cardiac output.

SHUNT

The greatest retardation in the rise of PA/PI is seen with the least soluble agent with increased shunt and shunt has least effect on more soluble agent.

ALVEOLAR TO VENOUS PRESSURE DIFFERENCE

This is the tissue uptake of the anaesthetic gases. The concentration of anaesthetic gases in blood cannot equilibrate with alveolar air, till the inhalational agent distribution to the tissues from the blood is almost complete. When this equilibrium have reached, the difference between the tension of the anaesthetic agent in the alveoli and the mixed venous tension decreases and then tension of the anaesthetic agent in the tissues increases. When this equilibration occurred the rate at which the agent diffuses from the alveoli into the blood progressively reduces.

TRANSFER FROM ARTERIAL BLOOD TO THE BRAIN AND TISSUES

The rate at which gas passes into the tissues depends on

1. Partition coefficient of blood to tissue
2. Blood flow to the tissues
3. The pressure difference of Artery to the tissue

TISSUE : BLOOD PARTITION COEFFICIENT

In lean tissue this value is nearly one. The rate at which the tension anaesthetic agent rises in the lean tissue varies directly with the arterial - tissue tension difference. The solubility of these agents in adipose tissue is greater than for that of blood. So at a state of equilibrium, the concentration of the anaesthetic agent in adipose tissues will be more than that in blood. Therefore concentration in the tissues will be more than that of blood even before the state of equilibration is reached.

TISSUE BLOOD FLOW

The delivery of an inhalational agent to a region and hence the speed at which equilibrium is reached varies directly with the amount of blood flow to a region. The total amount of gas uptake by the tissues depends on the tissue perfusion and the anaesthetic solubility. So the body compartments can be divided on the basis of level of perfusion and blood flow to the region

KINETICS OF TISSUE COMPARTMENT

GROUP	BLOOD FLOW %CO	BODY MASS	FLOW (L/HR)	EQUILIBRATION TIME
VRG	75	<10	45	3-10 MIN
MG	18-20	45-50	2	1-4 HRS
FG	5	15-20	1.3	<5 DAYS

Equilibration time is therefore important for the agents that are highly soluble.

ARTERY TO TISSUE PRESSURE DIFFERENCE

The inhalation agents tension in the tissue rises and the diffusion rate slows once the equilibrium is reached, as same as the lung uptake. This rate is determined by the tissue time constant, which is dependent on the capacity of the tissue and the blood flow to the tissues.

$$TC(t) = \frac{\text{TISSUE CAPACITY/100g}}{\text{BLOOD FLOW/100g}}$$

OTHER FACTORS AFFECTING UPTAKE AND DISTRIBUTION

CONCENTRATION AND SECOND GAS EFFECTS

The "concentration effect" is defined as the rate at which in arterial tension rises varies directly with the inspired concentration. For example when we are inspiring 75% N2O/O2 in the initial stages as much as 1l/min may move by diffusion into the blood stream from the alveoli. This causes the drawing increases amount of gas into the lungs from the circuit thus causes increase in minute ventilation. This effect causes the increased delivery of a second gas to the alveoli such as 1% halothane and increasing its diffusion into arterial blood.

ALTERATIONS IN VENTILATION AND PREFUSION

If the ventilation and perfusion increases proportionately, then the rate at which FA/FI increase is thought to remain the same. This would be the case, except for the increased rate of delivery of anaesthetic agent to the tissues and the increased rate of narrowing of difference in the tension between the alveoli and the mixed venous blood. Thus the rate of rise of FA/FI is increased. The magnitude of the acceleration of the rate of uptake of anaesthetic agent is dependent upon the distribution of the increase in cardiac output.

ELIMINATION OF INHALATION AGENTS

The factors which affect the elimination of an inhalation agents are almost same as for uptake and distribution. The same factors apply for changes in the anaesthetic depth. There are mainly differences two in no. between uptake and elimination

1. The increase in the rate of rise of FA/FI by overpressure is impossible.
2. All tissue groups have Pgas at induction = 0, whereas this value is different in different regions on elimination phase.

This is due to the time constants of muscle or lipid group have not come to equilibrium at this time. So the muscle group and lipid group continue to absorb the agent and so they cause a decline in FA/FI during the initial hours. The long time taken by vessel poor group to attain equilibrium has two effects

1. The rate at which the recovery occurs is more faster than the induction.
2. The rate at which the recovery is dependent on the duration of anaesthesia.

MOLECULAR ACTION OF INHALATIONAL ANAESTHETICS

NEURONAL TRANSMISSION INTERRUPTION

Till now there exists no data to clearly explain the action of the inhaled agents, but there are good evidence that different neuronal groups have different sensitivity to the inhalation agents.

The mechanism action of the inhaled agents on the alteration in the synaptic transmission may be due to changes in the following,

a. release of presynaptic neurotransmitter

b. neurotransmitter reuptake

c. binding to receptor sites

d. membrane conductance that occurs due to the receptor activation

From the observations in the ventral root of the spinal cord these agents appear to depress both monosynaptic and polysynaptic responses equally.

ALTERATIONS OF NEUROREGULATORS WITH ANAESTHESIA

Various observations have revealed that acetylcholine levels are not altered by any anaesthetic gases, however, there is a decrease in the rate of turnover. Its manufacture is decreased by N2O 70% or halothane 3%.

The catecholamine levels are not affected, however drugs which affect the NA availability greatly change the anaesthetic requirement. The levels of dopamine in the CNS seem to vary inversely with the anaesthetic requirement. The levodopa administration causes a dose-dependent decrease of MAC in rats. MAC is markedly reduced with the administration of a2-adrenergic agonists . Clonidine causes a decrease in MAC in dogs by 42%. Dexmedetomidine produces a MAC reduction in dogs to ~ 10% of the control value. This may be due to decrease in presynaptic release of NA , and also the depression of exitablity of neurons postsynaptically.

The levels of serotonin are unchanged, but there may be a increase in its levels in specific areas of brain like substantia nigra & dorsal raphe nucleus. The metabolism of GABA is decreased and its levels increases with the administration of 3% halothane. However, uptake and release of GABA are not affected. Most studies have demonstrated an increase in the levels of cyclic AMP in the CNS. This is due to the activation of adenylate cyclase and inhibition of phosphodiesterase, the levels of cGMP are reduced by the volatile agents. These may cause a change in the macromolecules involved in neuronal transport via alteration in phosphorylation.

In the 1970s it was hypothesised that the inhalational agents had action on the opiate receptors. This hypotheses was supported by the fact that the opiods

causes a reduction in MAC and the naloxone caused a partial reversal of action of inhalation agents. Another mechanism to support this hypothesis was that volatile agents may act by the release of endogenous opioids within the CNS.

In summary at present with available evidence, the mechanism of action of the volatile agents cannot be explained by depletion, production, or release of a single neurotransmitter.

THEORIES OF ANAESTHETIC ACTION

1. Lipid Solubility - Overton & Meyer

2. Alterations in Lipid Bilayer

    i. lipid perturbation - dimensional change

    ii. lipid phase transition - "lateral phase separation"

    iii. interaction of lipid-protein

3. Alteration of Protein Function - luciferase inhibition

THE PHYSICOCHEMICAL BASIS OF ANAESTHETIC ACTION

A variety of molecules can cause general anaesthesia, including inert gases, simple inorganic and organic molecules, haloalkanes, and ethers. The

unitary theory of narcosis states that all anaesthetics have a mode of action in common depending on a specific molecular structure

The anaesthetic potency was first best correlated with the partition coefficient of olive oil:gas by Meyer and Overton. The product of the anaesthetising partial pressure and the oil:gas partition coefficient varies little over ~ a 100,000 fold range of anaesthetising partial pressures. This varies between the species and in humans it

$$PGas \times tO:G \sim 1.28 \pm 0.09 \text{ bar}$$

The closeness of this relationship supports a unitary theory and suggests that when a certain number of anaesthetic molecules occupy a certain region in the CNS anaesthesia results. The Meyer-Overton rule suggests that it is the quantity rather than the type of molecules which are present at the site of action which is important for causing anaesthesia. Thus, additive nature of anaesthetic agents is supported by this hypotheses.

EXCEPTIONS TO THE MEYER-OVERTON RULE

Enflurane and Isoflurane are structurally similar and have more or less same oil:gas partition coefficients, but the minimum alveolar concentration of isoflurane is less than of enflurane. Thus, that there may be other factors which affect potency, they are

1. convulsant properties –reduction in anaesthetising capacity and the appearance of convulsant property occurred when the alkanes and ethers are completely halogenated

2. the "cutoff effect-the increasing numbered homologues exhibit a cut off point beyond whichanaesthetic potency sharply decreases. One theory is that the increased members of a series have a size that are large to occupy the "anaesthetic site"

HYDROPHILIC SITE OF ACTION

L. Pauling & S. Miller in 1961 independently proposed that formation of clatharates of water in membranes may be a reason of anaesthesia. The molecules causing anaesthesia may act as a seed for the proposed crystals of water which may cause a alteration in ion transport across membrane. This is a less accepted theory because the potency of an agent and its ability to form clathrates is poorly correlated.

Traube (1904), Clements & Wilson (1962) proposed that potency of a anaesthetic agent may be correlated with reduction of surface tension by the agent.

CRITICAL VOLUME HYPOTHESIS

There is no answer for why anaesthesia results according to meyer rule although it postulates that when certain no. of molecules bind to a certain site anaesthetia results. As anaesthetic action displays reversal with decrease in tension, Mullins (1954) proposed that potency of the anaesthetic agent may vary directly with both the solubility of the agent in lipid membrane and its molar volume. They suggested that when the volume of the lipophilic region expands more than some critical volume anaesthesia results. This theory is supported by a number of experimental observations,

a. The reversal of anaesthesia with reduction in hydrostatic pressure

b. expansion in volume of model lipid membranes

c. Poor lipid soluble gases like He and Ne have no anaesthetising property.

d. the potency of hydrogen is much more less than that predicted.

The facts against this hypothesis include,

a. decreasing temperature - decreases the relative volume expansion and this should cause an increase in anaesthetizing volume but actually opposite occurs

b. all lipid soluble agents are not anaesthetics

ANAESTHETIC BINDING TO MEMBRANE LIPIDS

All biological membranes are made of lipid bilayer, its thickness is 4nm. Peripheral proteins are bound to the outer water soluble membrane weakly but the integral proteins span through the lipid bilayer and are deeply embedded in it. Synaptic membranes consists of lipid and proteins in equal ratio. The relationship between the potency of an agent and its solubility in phospholipid bilayers are closely correlated as that of olive oil gas coefficient.

EFFECTS ON MEMBRANE PERMEABILITY

All inhalational agents causes an increase in cation flux across the synthetic liposomes according to many observations. This increase in magnitude of cationic flux is dependent on lipid composition of the membrane and the anaesthetic agent examined. High pressures (~ 100 Atm) causes a reversal of cationic fluxes. The lipid vesicles also exhibit similar effect. They suggest that the decrease in the normal gradient of ph across the vesicles causes the inability of vesicles to retain cathecolamines. This reduction in the levels of cathecolamine stores intraneuronally causes reduced transmission of impulses.

EFFECTS ON MEMBRANE DIMENSION

The lateral pressure in the cells are increased by the absorption of inhalation agents into the lipid bilayers. This may cause a change in the ion channel function. This effect is parallel to the theory of volume expansion. However, in vitro there is only a small increase in volume and it may be due to other factors,

a. raised hydration of the bilayer

b. alteration in the lipid water interactions

c. changes that occur confirmationally in the lipid phase

ALTERATION OF MEMBRANE PHYSICAL STATE

Increase in temperature causes the phospholipid membrane to go to a transition state called gel liquid crystalline transition of the lipid matrix.This change over causes an increase in the lipid volume. Trudell *et al.* (1973) proved that the anaesthetic gases causes the change in state to occurs at much lower temperature. This small change in fluidity of the membrane (~ 1-2%) cause an increase in cationic flux across liposomes. The lipids that surround the ion channels are held in the rigid gel state. The dissolution of this rigid gel state causes the channel closure. The fact that contradicts this idea is that the

hypothermia which decreases the fluidity of membrane but it causes a increase in anaesthetic potency. An alternative theory, is the "lateral phase separation hypothesis". According to this theory a local disordering in the phospholipid matrix is caused by these agents and they decrease the number of molecules which are simultaneously alternating between the liquid and crystalline states. By decreasing these transitions, these agents cause a decrease in the fluctuations of volume which occur in biological membranes.

Both the fluidization and lateral phase separation hypotheses states the same thing. Anaesthesia occurs due the fact that lipid membranes becomes more fluid. By the application of high pressure this fluidization may be reversed. These theories are opposed by the facts,

a. small increases in temperature (~ 1°C), causes a increase in fluidization as anaesthetic agents and hence hyperthermia should increase the depth of anaesthesia, which is not true.

b. increasing age causes the increase in rigid lipids, which should oppose this action. The MAC is actually less in aged.

ALTERATION OF PROTEIN FUNCTION

Most investigators are in the view that inhalation agents have their final pathway of action on the certain membrane proteins which are present in the neurons which are involved in ionic fluxes

SOLUBLE PROTEINS

Specific sites at which the anaesthetic agent binds have been identified in proteins like,

i. haemoglobin

ii. myoglobin

iii. serum albumin

This binding is readily reversible, and do not cause any alteration in most of the protein function. This affinity of anaesthetic gases to certain proteins which may be involve in neuronal excitability may explain the action of inhalational agent.

MEMBRANE PROTEINS

It is not possible to differentiate between effects on the surrounding membrane lipid and the effect on the proteins themselves. The ACh-receptor /

ionophore complex provides the best example in this regard. The receptor is stabilized in a state in which it forms a strong bond with the agonist molecules by the inhalation agents. Thus a desensitised closed channel is produced by the inhalational agent. There exists a close relationship between anaesthetic potency and increased binding affinity, but only less de-sensitisation occurs at the concentration of the inhalation agent used clinically. Also, decrease in ACh binding is caused by higher concentration of inhalation agent, there is no linear dose-response relationship.

Recent work also suggest that the membrane proteins may be a site where greater change in function of the membrane may be caused by a inhalation agent.

In summary, there are a large no. of theories and sites of action of inhalation agents yet the exact mechanisms of action of inhalational agents are unclear.

MINIMUM ALVEOLAR CONCENTRATION (MAC)

The potency of an inhalation agent is denoted by its minimum alveolar concentration. It is defined as the concentration of an inhalation agent in the alveoli that causes loss of movement in about 50 percent of individuals in response to a painful or noxious stimuli. The surgical skin incision is the usual

painful stimuli for the determination of MAC. MAC must exceed 1.3 times to facilitate or assure sufficient surgical anaesthesia for most of the patients.1.3 MAC will prevent movement in about 95% of the patients. The MAC represents the minimum concentration of the inhalational agent in the brain indirectly and hence it represents an useful index for measuring the potency of the inhalation agent. After equilibration the partial pressure of the anaesthetic gas in the lung becomes equal to the partial pressure in the brain.

MAC is dependent on age. It is lowest in new borns, peaks in infants and then progressively decreases as the age increases. The values of MAC for the anaesthetic gases are additive, (ie) the presence of nitrous oxide in the mixture decreases the MAC of the second anaesthetic gas. Administration of opiods also reduces the MAC of the inhalational agent administered. The hemodynamic responses to painful stimuli cannot be reduced or suppressed by inhalational agent alone . Also the MAC does not necessarily predict the brain concentration of inhalation agent that is necessary to avoid the motor responses for the noxious stimuli such as intubation. Hyperthermia and hypernatremia causes the increase in MAC. Hypothermia, hyponatremia, pregnancy, hypotension, and drugs such as lithium, lidocaine, opiods, and alpha 2 agonists like clonidine causes decrease in MAC.

MAC represents an unifying principle of measuring the depth of anaesthesia of different inhalation agents. In general the different anaesthetic gases have parallel dose-response curves across drugs and stimuli-response pairs though they have some pharmacological differences which differentiate one inhalation agent from another. MAC – it is the concentration inhaled anaesthetic at one atmospheric pressure that is necessary to prevent movement in response to a painful stimulus usually a skin incision in 50% of subjects.

eg. MAC of nitrous oxide – 104%, sevoflurane-1.8 to 2%.

MAC AWAKE- the concentration that is necessary to cause a response to oral commands in 50% of patients. The MAC awake for nitrous oxide (65% of MAC) is more than that desflurane, isoflurane, sevoflurane (approximately 33% of MAC) when expressed as a fraction of MAC.

MAC BAR – the alveolar concentration of the inhaled anaesthetic that is necessary to blunt or suppress the hemodynamic response in 50% of patients.

LOW FLOW ANAESTHESIA

DEFINITION

Any technique that utilises a fresh gas flow (FGF) that is less than the alveolar ventilation can be classified as Low flow anaesthesia. Baum et al had defined it as a technique wherein at least 50% of the expired gases had been returned to the lungs after carbon dioxide absorption. This would be satisfied when the FGF was less than about two litres per minute. Baker, in his editorial had classified the FGF used in anaesthetic practice into the following categories:

Metabolic flow	:	about 250 ml /min
Minimal flow	:	250-500 ml/min.
Low flow	:	500- 1000 ml/min.
Medium flow	:	1 - 2 l/min.

For most practical considerations, utilisation of a fresh gas flow less than 2 litres/min may be considered as low flow anaesthesia.

THE NEED FOR LOW FLOW ANAETHESIA

Completely closed circuit anaesthesia is based upon the reasoning that anaesthesia can be safely be maintained if the gases which are taken up by the body alone are replaced into the circuit taking care to remove the expired carbon dioxide with sodalime. No gas escapes out of the circuit and would provide for maximal efficiency for the utilisation of the fresh gas flow. The very nature of

this system requires that the exact amount of anaesthetic agent taken up by the body be known, since that exact amount has to be added into the circuit. Any error in this could lead to potentially dangerous level of anaesthetic agent be present in the inspired mixture with its attended complications. Hence, there exists a need for a system that provided the advantages of the completely closed circuit and at the same time, reduced the dangers associated with it. Low flow anaesthesia fulfilled these requirements.

Low flow anaesthesia involves utilising a fresh gas flow which is higher than the metabolic flows but which is considerably lesser than the conventional flows. The larger than metabolic flows provides for considerably greater margin of safety and satisfactory maintenance of gas composition in the inspired mixture. Strict compliance to the uptake is not necessary. Hence, the conduct of anaesthesia is greatly simplified and at the same time provides for the economy of the fresh gas flows.

ADVANTAGES OF LOW FLOW ANAESTHESIA

REDUCTION IN THE CONSUMPTION OF ANAESTHETIC GASES

Low flow anaesthesia is associated with the significant decrease in the usage of the inhalation agents and the anaesthetic gases. A study which compared the usage of gases between high flow with fresh gas flow of 5-6l/min with the minimal flow with the fresh gas flow of 0.5l/min in isoflurane

anaesthesia showed that the consumption of oxygen decreased by 1151 and that of nitrous oxide decreased by 3001 and the isoflurane by 5.61.

ECONOMICAL ADVANTAGE

A reduction in the usage of anaesthetic gases and the inhalation agents will naturally have an economic advantage reducing the net expenditure.

DECREASED POLLUTION

High flow anaesthesia results in the pollution of the environment beyond the operation room. This occurs even if the boyles apparatus is kept with no leaks.

Anaesthesia with higher fresh gas flow will result in pollution of the atmosphere beyond the operating theatre. N2O and inhalation anaesthetics causes a destruction of the ozone layer and adds to the green house effect. The fluorinated anaesthetic vapours like desflurane and sevoflurane is believed to be devoid of ozone depleting property.

IMPROVED 'CLIMATE OF ANAESTHETIC GASES

The proper function and the maintenance of integrity of the ciliated epithelium is helped by the proper humidification and warming of anaesthetic gases. The breathing system technical design, the absorber size, the length and heat conduction of the breathing system tubings, the temperature, the pattern of the ventilation and the proportion of rebreathing determines the condition of the

anaesthetic gases which reaches the subject. Naturally the humidity of anaesthetic gases is greater in low-flow than in high-flow anaesthesia, where rebreathing is high. Although the specific heat of anaesthetic gas is low, by supplying humidified gaeses significant heat loss can be avoided. After a period of **30-45** min the above said optimum conditions of the inspired gases can be achieved in low flow technique.

Though, at present there exists no evidence to say the maintaining optimum conditions of the inspired gases for short to medium duration may reduce the post operative respiratory complications, there is an advantage of maintaining conditions close to physiological conditions without altering the function of the ciliated epithelium with the low flow technique.

MONITORING

Inspired O2 concentration should be monitored at all times if N2O is used in more than 65% concentration, as one of the adjuvant gas. EtCO2 monitoring seems to be necessary to ensure proper functioning of the absorber. If monitoring of end tidal anaesthetic concentration is available, the administration of low flow anaesthesia becomes very easy. In the absence of that a few calculations have to be carried out for deciding on the amount of anaesthetic agent to be added to the system.

REQUIREMENT FOR THE USE OF LOW FLOW ANAESTHESIA

1. A leak free boyles apparatus
2. Boyles machine should be fitted with the flow meter which is calibrated down to 50ml/min.
3. Role of soda lime: efficient CO2 absorption is must. Requires frequent changing of soda lime.
4. FiO2 monitor
5. Capnography
6. End tidal anaesthetic gas monitoring: the biggest problem with the low flow anaesthesia is the unpredictability of anaesthetic concentration. Our vaporisers are calibrated for high flows. Once low flow anaesthesia in initiated the disparity between the vaporizer dial setting and the inspired concentration of the agent becomes wide.

THE PRACTICE OF LOW FLOW ANAESTHESIA

THE INITIATION OF LOW FLOW ANAESTHESIA

If low flow is kept from the time of induction, there are some unique problems. The amount of vaporization from the vaporizer may not be adequate enough to build up the anaesthetic concentration in the alveoli. The usual requirement of the anaesthetic agent is 40-50ml of vapour per minute. To deliver

this, with an FGF of 1L/min, the dial setting must be 5% which is not usually employed during high flow.

The factors like the total volume of the circuit, FRC of the lung, alveolar ventilation, cardiac output, blood gas solubility, alveolar venous partial pressure gradient all tend to affect the inhalation agent concentration in the low flow anaesthesia.

Some methods suggested for initiation of low flow anaesthesia for avoiding long time to build up anaesthetic concentration and to avoid low anaesthetic depth.

1. USE OF HIGH FLOWS FOR SHORT TIME: By using high flows for a short time, the time constant is reduced thereby bringing the circuit concentration to the desired concentration rapidly. Often a fresh gas flow of 10 l of the desired gas concentration is used so that by the end of three minutes the circuit would be brought to desired concentration (three time constants). The large flows and high agent concentration also compensate for a large uptake seen at the start of the anaesthesia.

   The major advantage of this method is the rapidity with which the desired concentration is achieved. This also has the added advantage of achieving lung denitrogenation, so vital to the conduct of low flow anaesthesia. The prime disadvantage would be the high flows required

which would compromise the economy of gas utilization and the need for scavenging systems to prevent theatre pollution.

2. PREFILLED CIRCUIT: The second method is utilizing a different ciruit like magill's for pre oxygenation. Simultaneously the circle system is fitted with a test lung and the entire circuit is filled with the gas mixture of the desired concentration. Following intubation the patient is connected to the prefilled circuit thereby ensuring rapid achievement of the desired concentration in the alveoli.
3. USE OF LARGE DOSES OF ANAESTHETIC AGENTS: The third method consists of adding large amounts of anaesthetic agents into the circuit so that the circuit volume+FRC rapidly achieve the desired concentration. This involves setting the vaporizer to deliver a large amount of the agent while using low to moderate flows so that the required amount of vapour is added to the circuit. The vaporizer setting can be brought down to 0.5-0.8% after 10min and titrated according to the surgical need.
4. INJECTION TECHNIQUE: An alternative method for administering the large amounts of the agents is by directly injecting the agent into the circuit, a form of VIC. This is an old, time-tested method and is extremely reliable. Each ml of the liquid halothane, on vaporisation yields 226 ml of

vapour and each ml of liquid isoflurane yields 196 ml of vapour at 20˚C. Hence, the requirement of about 2ml of the agent is injected in small increments into the circuit. The high volatility coupled with the high temperature in the circle results in instantaneous vaporisation of the agent. The injection is made through a self sealing rubber diaphragm covering one limb of a metal t piece or a sampling port, inserted into either the inspiratory or the expiratory limb. The injection is made using a small bore needle and a glass syringe. Placing a gauzepiece or a wire mesh inside the T piece often helps in the vaporisation of the liquid. The intermittent injections are often made in 0.2-0.5 ml aliquots manually. Doses should never exceed 1ml at a time. Doses exceeding 2 ml bolus invite disaster. Intermittent injections can often be easily substituted with a continuous infusion with the added advantage of doing away with the peaks and troughs associated with intermittent injections. The exact dose to be used is calculated thus:

Priming dose (ml vapour) = Desired concentration x {(FRC + Circuit volume)+(Cardiac output x BG Coeff.)}

The Cardiac output and the FRC can be estimated for the patient based on standard nomograms. This priming dose is the dose required to bring the circuit volume + FRC to the desired concentration and is

injected over the first few minutes of the closed circuit anaesthesia. Besides this, an amount of agent necessary to compensate for the uptake of the body must also be added and this is calculated depending on the uptake model being used

MAINTAINENCE PHASE

The phase is characterized by

1. Need for a steady state anaesthesia often meaning a steady alveolar concentration of respiratory gases.
2. Minimal uptake of anaesthetic agents by the body.
3. Need to prevent hypoxic gas mixture

MANAGEMENT OF THE N2O FLOW DURING THE MAINTAINENCE PHASE

This is very important because of the possible danger of administering hypoxic mixture. For eg. If 33% of O2 500ml and 1000ml of N2O is administered. O2 is taken at a constant rate of 4ml/kg /min.N2O relatively insoluble gas and after the initial equilibration with the FRC and the vessel rich group the uptake of N2O is considerably reduced. In this situation there is a constant removal of O2 at a rate of 200-250ml/min whereas the insoluble N2O

uptake is minimal. Hence the gas that is partly vented and partly returning to the circuit will have more N2O and less of O2. Over a period of time , due to the mixing of fresh gas that has 66% N2O and the expired CO2 free gas that has N2O much higher than that the percentage of N2O will go up and that of O2 will fall, sometimes dangerously to produce hypoxic mixtures.

MAINTAINENCE WITHOUT N2O

Low flow anaesthesia can also be given using medical air as carrier gas or 100% O2. Here hypoxic mixture delivery is not possible whereas proper maintenance of depth of anaesthesia needs to be taken care of.

MANAGEMENT OF INHALATION AGENTS DURING MAINTAINENCE PHASE IN LOW FLOW ANAESTHESIA

The relation between the concentration set on the dial of the vaporizer and the alveoli is dependent on two factors in low flow anaesthesia

1. The uptake of the inhalation agent from the alveoli – FD/FA is higher for more soluble agents and in the early 5 to 10 min of anaesthesia where uptake vessel rich group takes place.

2. The inflow rate – the increase in flow rate decreases the FD/FA thus reducing the rebreathing. The uptake causes the depletion of anaesthetic during rebreathing thus compensation is necessary.

FD/FA is described as anaesthetic tether, most anaesthetist prefer short anesthetic tether (ie) low FD/FA as it provides tighter control over the depth of anaesthesia, and safe in times where gas analyser is not present, which inturn produced by less soluble agents, high inflow rates or both.

The low flow anaesthesia, according to above said facts, is best possible with less soluble agents and application of high flows at the initiation of anaesthesia for first 5 to 10 min then maintaining with low flows.

OXYGEN, NITROUS OXIDE AND INHALATION ANAESTHETIC UPTAKE

During the anaesthesia, the basal metabolic rate determines the patient oxygen uptake . An estimate of oxygen consumption is calculated by the modified brody equation.

$$VO2=10\times BW\ kg3/4$$

Nitrous oxide uptake follows an exponential function. It is more during the first few minutes of anaesthesia. When the tissue compartments become

saturated the uptake slows down then. Severinghaus equation gives the estimate of nitrous oxide uptake.

$$VN20=1000\times t-1/2$$

Exponential equation given by Lowe helps in the estimation of inhalation agent uptake over time

$$VAN=f\times MAC\times \lambda B/GQ\times t-½$$

In the equation said above the fx MAC is 0.8 MAC which is the required expiratory concentration of the anaesthetic agent.

The Lowe rule states the amount of anaesthetic agent consumed at any point of time is equal to the amount consumed at first minute divided by square root of time in minutes.

CONDUCT OF LOW FLOW ANAESTHESIA WITH OXYGEN,N2O AND INHALATION AGENT

The induction of low flow anaesthesia is similar to that of conventional methods: Following pre-oxygenation, an opioid and hypnotic agent and if desired, a muscle relaxant is given. Then the intubation is done. After confirming the position the tube is secured in position the patient is then connected to the closed circuit. Initially the anaesthesia is maintained with

high fresh gas flow (4-6 L/min) .This is done to achieve adequate denitrogenation and distribution of anesthetic gases through the circuit in appropriate concentration to achieve adequate depth of anaesthesia. The duration of the initial phase is dependent on the amount of flow reduction and the individual gas uptake (4-5 L/min, 6-8 min). Following the initial phase the concentration of oxygen becomes 30% and the nitrous oxide 65%. The isoflurane dial is turned to 1.5%, sevoflurane to 2.5% and for desflurane it is 4-6%. This concentration is required to achieve 0.8 MAC after 6-8 minutes.With this the addition of 50-60% nitrous oxide helps in achieving 1.3MAC.

The total gas uptake of an adult patient becomes about 600 ml/min after 10minutes, so the flow can be reduced to 1.0 L/min after 10 minutes and initiation of low flow anaesthesia can be done. In low flow anaesthesia the inspiratory concentration of oxygen can be maintained at least 30% only if the Fio2 is atleast 50%.

The amount of the anesthetic agent introduced into the circuit is also reduced once the low flow is initiated. So for maintaining 0.8 MAC the dial setting of the vaporizer should be atleast 3%. But for desflurane, no changes are necessary.

In low flow technique the oxygen concentration should be atleast 50% because of rebreathing. The fresh gas concentration of isoflurane is to be increased to 2.5%, enflurane and sevoflurane to 3.5% and desflurane is increased 1% above the initial setting in order to achieve the required 0.8MAC.

SEVOFLURANE

Sevoflurane was first synthesized in the late 1960s at Baxter laboratories by R F Wallin and co workers. The first published recorded use in humans was in 1981.

PHYSICAL PROPERTIES:

1. Sevoflurane (fluromethyl 2,2,2-trifluoro-1-[trifluoromethyl] ethyl ether) belongs to the halomethyl polyfluoroisopropyl ether group of compounds.
2. It is a colourless, non flammable, non irritating liquid at room temperature.
3. Molecular weight – 200.5 dalton
4. Boiling point – 58.5˚c
5. MAC – 2.0%, MAC – 0.6%
6. VAPOUR PRESSURE AT 20˚C – 160mmhg

7. BLOOD GAS PARTITION COEFFICIENT – 0.65

8. BRAIN BLOOD PARTITION COEFFICIENT – 1.7

PHARMACOKINETICS:

The sevoflurane is poorly soluble in blood. The partition coefficient of blood: gas is 0.69 in adults and 0.66 in newborns. The rate of increase or decrease (ie) the washout of alveolar partial pressures of sevoflurane in adults is intermediate between that of desflurane and isoflurane. It undergoes minimal metabolism in vivo to "hexafluoroisopropanol" and inorganic fluoride by cytochromes. The metabolism of sevoflurane in the kidneys by defluorination is supposed to be the main reason for nephrotoxicity after its use.

PHARMACODYNAMICS:

CENTRAL NERVOUS SYSTEM:

Sevoflurane produces a rise in ICP due to its cerebro vasodilatory effects in a dose dependent fashion during spontaneous respiration, but sevoflurane may facilitate maintenance of normal ICP when slight hypocapnia is maintained. It appears that Cerebral blood flow autoregulation appears is maintained during the administration of sevoflurane. It is similar to isoflurane in causing suppression of somatosensory evoked potential.

CARDIOVASCULAR SYSTEM:

Through a action on calcium channels it produces a direct myocardial depression. It produces a dose dependent decrease in cardiac output and a decrease in systemic vascular resistance which inturn causes a reduction in arterial blood pressure.

It produces a non dose dependent reduction in pulmonary artery pressure. The blood flow to the liver and kidneys and the liver are maintained.

RESPIRATORY SYSTEM:

Sevoflurane depresses ventilation causing a reduction in minute volume and also decreases the ventilator response to hypercarbia in a dose dependent fashion. It is sweet smelling and a negligible or no irritant effect on the respiratory tract. Also it has a partition coefficient of blood gas low which makes it best suited for inhalation induction. Sevoflurane is a effective bronchodilator.

CLINICAL USE:

It is best suited for inhalation induction. It is inhalation agent agent of choice in pediatric age group.

SEVOFLURANE IN LOW FLOW ANAESTHESIA

Sevoflurane is degraded in canister by the carbon di oxide absorbents. The most important among them is the haloalkene which is known as the compound A. this compound is nephrotoxic in rats when the rate of exposure is about 150-340 ppm-hr. The concentration of compound A is high on aacumulation in low flow sevoflurane raised many controversies in using low flow sevoflurane anaesthesia and its potential to cause nephrotoxicity. One group of observers found that on administering low-flow sevoflurane involunteers it resulted in intact renal function although they noted a transient increase of markers of renal function like urine excretion of protein, glucose, and certain tubular enzymes which are experimental. This "transient renal injury" was contributed to the formation of compound A. Also they calculated the threshold level of compound A to cause renal injury in humans was about 150ppm-hr and they also said that the humans are of sensitive to compound A as that of rats.

However, the above conclusion have not been confirmed by other groups yet. Several studies have that the humans and rats differ in metabolism and uptake of glutathione and cysteine residues of compound A. So the threshold of compound A in rats do not apply to humans. Till date studies which included the protein excretion(more sensitive for renal injury) have not shown threshold levels in humans even in exposure of about 500ppm-hr.

So from all the studies published till date it can be conclude that there is no difference between low flow sevoflurane anaesthesia and other inhalation agents with respect nephrotoxicity. This also in the subjects with preexisting renal impairment. Also till date no reports of renal injury caused by compound A in humans have been reported. Thus there are no evidence to say that low flow sevoflurane anaesthesia is not safe.

Compound A is produced by breakdown of sevoflurane in the presence of soda lime or Baralyme and not by the metabolism in our body. Changing or reducing potassium hydroxide or sodium hydroxide have made it safe from compound A.

AMBULATORY SURGERY

First out-patient surgical facility was established by *WALLACE REED,* an anesthesiologist.

REASONS FOR INTRODUCTION OF AMBULATORY SURGERIES

1. Availability of rapid , short acting anesthetics , analgesics & muscle relaxants
2. Minimally invasive surgical techniques
3. Cost effectiveness.

BENEFITS OF AMBULATORY SURGERIES

1. Patient preference
2. No dependence on hospital bed availability
3. More flexible scheduling of surgeries
4. Lesser morbidity and mortality
5. Lower incidence of infection
6. Lower incidence of respiratory complications
7. Higher volume of patients

8. Lower overall procedural costs

9. Shorter surgical waiting lists

PATIENT SELECTION CRITERIA

1. ASA status: I ,II, III (& even some IV)

2. Duration of surgery < 90 minutes (upto3–4 hrs)

3. Risk minimisation by stabilisation of medical conditions 3 months prior to surgery.

The following are not an exclusion criteria anymore

1. Extremes of age

2. Susceptibility to malignant hyperthermia.

3. BMI > 40 kg / m2

PROCEDURES SUITABLE FOR AMBULATORY SURGERIES

1. Dental -Extraction, restoration, facial fractures

2. Dermatology -Excision of skin lesions

3. General -Biopsy, endoscopy, excision of masses, hemorrhoidectomy, herniorrhaphy, laparoscopic cholecystectomy, adrenalectomy, splenectomy, varicose vein surgery

4. Gynecology -Cone biopsy, dilatation and curettage, hysteroscopy, diagnostic laparoscopy, laparoscopic tubal ligations, uterine polypectomy, vaginal hysterectomy

5. Ophthalmology -Cataract extraction, chalazion excision, nasolacrimal duct probing, strabismus repair, tonometry

6. Orthopedic - Anterior cruciate repair, knee arthroscopy, shoulder reconstructions, bunionectomy, carpal tunnel release, closed reduction, hardware removal, manipulation under anesthesia and minimally invasive hip replacements

7. Otolaryngology - Adenoidectomy, laryngoscopy, mastoidectomy, myringotomy, polypectomy, rhinoplasty, tonsillectomy, tympanoplasty

8. Pain clinic - Chemical sympathectomy, epidural injection, nerve blocks

9. Plastic surgery - Basal cell cancer excision, cleft lip repair, liposuction, mammoplasty (reductions and augmentations), otoplasty, scar revision, septorhinoplasty, skin graft

10. Urology - Bladder surgery, circumcision, cystoscopy, lithotripsy, orchiectomy, prostate biopsy, vasovasostomy, laparoscopic nephrectomy and prostatectomy

CONTRAINDICATIONS FOR AMBULATORY SURGERY

1. Potentially life threatening illnesses

2. Morbid Obesity complicated by symptomatic cardiorespiratory problems

3. Multiple c/c centrally active drug therapies or drug abuses

4. Ex-premature infants< 60 weeks post conceptual age requiring general endotracheal anesthesia

5. No responsible adult at home to care for the patient on the evening after surgery

CHARACTERISTICS OF IDEAL ANAESTHETIC AGENT FOR AMBULATORY SURGERY

1. Rapid and smooth onset of action

2. Intraop amnesia and analgesia

3. Provide optimal surgical conditions

4. Adequate muscle relaxation

5. Short recovery period

6. No adverse effects in post discharge period.

MONITORING

1. ECG

2. Blood pressure cuff

3. Temperature probe

4. Capnograph

5. Pulse oximeter

6. Neuromuscular monitor if NDMR used.

7. Cerebral monitor may be useful.

POST OPERATIVE COGNITIVE DYSFUNCTION

The impairment or reduction in the mental processes of perception, memory and information processing which helps a person to acquire knowledge, solve the problems and to plan for the future is defined as the cognitive dysfunction. It is a common complication in postoperative patients that stops from early discharge. The incidence of POCD is relatively high even though the technical advances have led to the remarkable decrease in the morbidity and mortality post operatively. The recovery after surgery is not only compromised or delayed but if if persistent compromises the surgery itself..

The risk factors for POCD can be broadly divided into age dependent, comorbidity-dependent, and those related to surgery and anesthesia. Substance abuse, preexisting psychiatric and neurological disorders, and conditions with high intracranial pressure represent some of the most common risk factors associated with comorbidity. The incidence of POCD increases with increasing age. The type of surgery and anasethesia and the duration of anaesthesia also plays a important role in determining the POCD. The cardiovascular surgeries, urologic surgeries are associated with increased incidence of POCD when compared to other surgeries. In cardiac surgery - the incidence of POCD is mainly due to the use of cardiopulmonary bypass – which is 50-80% at

discharge, 20-50% 6 weeks after surgery, and 10-30% 6 months after operation.

Every areas of the brain are not uniformly affected by the anaesthetic agents. Some areas of the brain are extremely sensitive than others. For example, the sedative concentrations of anesthetics inhibit activity in "multimodal association cortices" such as parietal and prefrontal cortices, represents the sensitive areas of the brain to the anaesthetic agents. They are responsible for the attention and its inhibition causing amnesia. In contrast, unimodal cortices like thalamus are largely unaffected by the anaesthetic agents. This has led the investigators to work on the degree of involvement of anesthesia in the incidence of POCD. The incidence of POCD are not determined by anaesthesia alone but it is a additive effects of surgery, stress response to surgery, anxiety pre operatively and so on.

SEVOFLURANE AND POST OPERATIVE COGNITIVE DYSFUNCTION

Sevoflurane is the inhalational agent of choice in recent times owing to its properties like sweet smell, poor solubility allowing rapid induction and rapid recovery. The studies on this drug relating to the POCD have resulted in the conflicting results. A study which investigated the use of sevoflurane in patients undergoing CABG have revealed that no relationship exists between POCD and use of sevoflurane. In contrast, some comparative studies of sevoflurane and other volatile anesthetics, such as desflurane and isoflurane, have shown that the sevoflurane is associated with more cognitive dysfunction than the other two. Other studies have revealed that both sevoflurane and desflurane is associated with good recovery of cognitive function and sevoflurane is associated with good recovery when compared to isoflurane. Also total intravenous anesthesia with propofol / remifentanil- is associated with no patient benefit in terms of recovery when compared to sevoflurane / fentanyl based anaesthesia. Recovery is faster after sevoflurane / fentanyl based anaesthesia than after propofol / remifentanil. Thus association of sevoflurane with post operative cognitive dysfunction have resulted in conflicting results.

MINI MENTAL STATE EXAMINATION (MMSE)

Mini mental state examination score is used to assess the post operative cognitive dysfunction in this study. The Mini Mental State Examination (MMSE) can assess the mental status both systematically and thoroughly. It consists of 11 question that mainly concentrates on five areas of cognition viz orientation, registration, attention and calculation, recall, and language. The maximum score is 30. Cognitive impairment is said to be present when the MMSE score is less than 23. It takes only 5-10 minutes to examine the patient with MMSE and so can be used repeatedly and routinely. This tool can effectively distinguish the patients with cognitive dysfunction and normal patients. Also it can be used repeatedly to monitor the improvement in the patients with intervention. However, it is not a diagnostic tool and cannot replace clinical examination of mental status. In order to assess the patient with MMSE the patient must be able to write, understand the language. Also it cant be used in intubated patients and in visually and hearing impaired patients. Also the repeated use of the same questions may make the patients aware of the questions and can result in false scores.

The mini mental state examination

Orientation

Year, month, day, date. season	_____/5
Country, county, town, hospital, ward (clinic)	_____/5

Registration

Examiner names three objects (for example, apple, pen, and table)	
Patient asked to repeat objects, one point for each.	_____/3

Attention

Subtract 7 from 100 then repeat from result, stop after five subtractions. (Answers: 93, 86, 79, 72, 65)	
Alternatively if patient errs on subtraction get them to spell world backwards: D L R O W	
Score best performance on either task.	_____/5

Recall

Ask for the names of the objects learned earlier.	_____/3

Language

Name a pencil and a watch.	_____/2
Repeat: 'No ifs, and or buts.'	_____/1
Give a three stage command. Score one for each stage (for example, 'Take this piece of paper in your right hand, fold it in half and place it on the table.'	_____/3
Ask patient to read and obey a written command on a piece of paper stating: 'Close your eyes.'	_____/1
Ask patient to write a sentence. Score correct if it has a subject and a verb.	_____/1

Copying

Ask patient to copy intersecting pentagons.	
Score as correct if they overlap and each has five sides.	_____/1

Total score: _____/30

EMERGENCE FROM ANAESTHESIA

Recovery from anaesthesia is a time of physiological stress to the patient. Emergence from general anaesthesia should be smooth and to be one in a controlled environment. The speed of recovery from inhalation anaesthesia is directly proportional to the alveolar ventilation and inversely proportional to the blood solubility. Recovery is faster for low soluble agents like desflurane and nitrous oxide and slower for more soluble agents like halothane and enflurane. Hypoventilation delays the recovery.

Recovery from inhalation agents is primarily dependent on the redistribution reather on the elimination half life. As the total dose increases the cumulation causes the recovery dependent on the elimination half life. Also the advanced age, renal or hepatic dysfunction can prolong recovery. The increase in the health costs and improved surgical and anaesthetic techniques have increased the no. of cases done as day care surgeries. Day care or ambulatory surgeries require the increased use of regional anaesthetic techniques and drugs of short duration of action. Top priorities for day care surgeries are alertness, analgesia, alimentation and ambulation which when not attained can stop the patient from discharged. Rapid recovery from the short acting agents have introduced a concept of fast tracking and bypassing the post anaesthesia recovery unit. Various guidelines for managing patients in the PACU. The

patients should be monitored for post operative complications of like hypoxemia, nausea and vomiting, shivering, hypothermia, airway obstruction. No patient should be returned to the ward until control of postoperative nausea and vomiting and pain is satisfactory. All appropriate monitoring to be available in the PACU like ECG. Pulse oximetry, NIBP, and if the patient is intubated capnography is required.

POST ANAESTHESIA RECOVERY SCORES

Minimum criteria that must be followed before discharge of patients from the post-anaesthesia care unit have been framed

• The patient should be conscious, have gained back the protective airway reflexes and able to maintain a clear airway

• Breathing and oxygenation should be good

• The cardiovascular system should bestable, the values of blood pressure heart rate should be within the acceptable limits of pre op levels.

• control of pain and postoperative nausea and vomiting should be done,

• Temperature should be normothermic.

• Oxygen therapy should be supplemented if necessary.

• Patent IV cannulae should be present. They should be flushed IV fluids supplemented as necessary

• Checking of all surgical drains and catheters

MODIFIED ALDRETE SCORE

Variable	Score	Interpretation
Activity	2	moves all extremities voluntarily/on command
	1	moves two extremities voluntarily/on command
	0	unable to move extremities voluntarily/ on command
Respiration	2	able to breathe deeply and cough freely
	1	dyspneic, shallow breathing
	0	apneic
Circulation	2	able to breathe deeply and cough freely
	1	dyspneic, shallow breathing
	0	apneic
Consciousness	2	fully awake
	1	arousable on calling
	0	not responding
O_2 Saturation	2	able to maintain O_2 saturation more than 92% on room air
	1	supplemental O_2 required to maintain SpO_2>90%
	0	SpO_2<90% with O_2 supplementation

Maximum score = 10. Low score= equal or less than 6; High recovery score=7-10

REVIEW OF LITERATURE

1. *Chen X, Zhao M, White PF et al. comparison of desflurane and sevofluranein recovery of cognition in elderly adults. Anesthesia Analgesia 2001*

They studied the cognitive function after general anaesthesia with desflurane and sevoflurane in elderly adults. The ethical committee approval obtained. 70 ASA I-III elderly patients (> or =65 yr old) undergoing total knee or hip replacement procedures were randomized to get sevoflurane or desflurane anaesthesia. Anaesthesia was induced with Propofol and fentanyl. Anaesthesia was maintained with desflurane 2%-4% or sevoflurane 1%-1.5% with nitrous oxide 65% in oxygen. The concentrations of desflurane and sevoflurane were adjusted to maintain comparable depths of anaesthesia using the BIS monitor. The cognitive function was assessed with the MMSE score preoperatively and postoperatively at 1, 3, 6, and 24-h intervals. They concluded that, desflurane had faster recovery. However, recovery of cognitive function was similar in both groups.

2. *Raeder J, Gupta A, Pedersen FM. Comparision of recovery of sevoflurane or propofol based anesthesia in day care surgeries.Acta Anaesthesiology Scandinavia 1997.*

One hundred and sixty-nine elective outpatients to undergo knee arthroscopy were selected. Anaesthesia was induced with fentanyl and propofol. Anaesthesia was maintained with 60% nitrous oxide in oxygen through a laryngeal mask and continuous administration of either sevoflurane or propofol infusion titrated to maintain stable hemodynamics. They reported that maintenance of anaesthesia with sevoflurane had a faster recovery but associated with higher incidence of nausea and vomiting compared to propofol. The side-effects were meager in their study, and no difference in the time for discharge in both groups.

3. *Hadzmiaeet al. Journal of Health Sciences 2013 Cognitive function recovery in early postoperative period: comparison between propofol, sevoflurane and isoflurane.*

They compared the recovery of cognitive function at 1, 5, and 10 minutes following extubation in patients undergoing microdissectomy surgeries. They were randomized to receive three different anaesthetics (propofol, isoflurane and sevoflurane).This was done using the short

Orientation-Memory-Concentration (OMC) Test. They concluded that fastest recovery of cognitive performance appears after propofol anesthesia, followed by sevoflurane based anesthesia and isoflurane anesthesia.

4. *Larsen B et. al. comparision of sevoflurane, desflurane, remifentanyl-propofol anaesthesia in recovery of cognitive function Anaesthesia Analgesia 2000; 90: 168-174*

They compared the recovery characteristics of sevoflurane-N2O, desflurane-N2O with the propofol remifentanyl anaesthesia. The sevoflurane and desflurane group received fentanyl 2μ/kg. T he depth of anaesthesia was maintained on the basis of hemodynamic stability. The immediate recovery characteristics and time for aldrete score > 9 was noted. The recovery of cognitive function was also noted. They concluded that the recovery was better with remifentanyl propofol anaesthesia. Cognitive function was also better with propofol remifentanyl anaesthesia when compared to desflurane or sevoflurane anaesthesia

5. *Frink EJ Jr,et al. Quantification of the degradation products ofsevoflurane in two carbondi oxide absorbants during low-flow anesthesiain surgical patients. Anesthesiology 1992*

Sevoflurane anesthesia was administered to 16 patients using a circle absorption system with O2 flow of 500 ml/min and average N2O flow of 273 ml/min. Preoperative and postoperative hepatic and renal function studies were performed. The patients were randomized to receive sevoflurane low flow anaesthesia with sodalime or baralyme. The gas samples collected at the inspiratory and the expiratory limb were examined for the degradation products. CO2 absorbant temperatures were measured during anesthesia. Of the degradation products analyzed, only one compound [fluoromethyl-2, 2-difluoro-1-(trifluoromethyl) vinyl ether], designated compound A, was detectable. The Concentration of compound A steadily increased during the first 4 h of anesthesia with soda lime and baralyme and then declined between 4 and 5 h when baralyme was used. There were no significant difference between the concentrations of compound A between the two absorbents.

6. *Davison LA, Steinhelber JC, Eger EI II, Stevens WC. Comparision of psychological effects of halothane and isoflurane anesthesia. Anesthesiology 1975*

The effects of halothane and isoflurane anaesthesia on psychological function assessed pre operatively and 2,3,4,6,8, and 30 days after anaesthesia. These results with each agent were compared with each

other and with the results of unanesthetized controls. Changes in function were greatest 2 days after anesthesia; function had returned to near preanesthesia values 8 days after anesthesia. The effects produced by halothane was much greater than that of isoflurane. The differences can be explained on the basis of their solublities and metabolism.

7. *Heavner JE, et al,.Recovery from two or more hours of desflurane or sevofluraneanaesthesia in elderly patients. Br J Anaesth 2003*

The patients aged more than 65 years posted for surgery greater than 4 hours duration are included. They concluded that there were differences in early but not intermediate recovery times of elderly patients undergoing surgeries more than 4 hours. The early recovery times were earlier in desflurane group rather than the sevoflurane group.

8. *Bito H, Ikeda K. Effects of total flow rate on the concentration of degradation products in sevoflurane anaesthesia Br J Anaesth 1999.*

Both the concentration of compound A and the temperature produced by the degradation products were higher with fresh gas flow rate of 1l/min. though they reported no abnormalities in renal or hepatic function of patients receiving low flow sevoflurane anaesthesia, they could not confirm the safety of sevoflurane anaesthesia.

9. *The effects of sevoflurane on serum creatinine and blood urea nitrogen concentrations: Mazze RI1et al. Anesthesia Analgesia. 2000 Mar.*

They found no alteration in the serum creatinine or BUN concentrations in patients receiving sevoflurane anaesthesia of less than 4 MAC / hour.

10. *Hepatorenal effect of prolonged low-flow sevoflurane anesthesia on patients with renal impairment Ayman I Tharwat MD,et al. Ain Shams Journal of Anesthesiology 2011*

Surgical patients with renal impairment who received prolonged low or high flow sevoflurane anesthesia showed evidence of transient and mild hepatorenal dysfunction postoperatively. It is unlikely to be due to serum fluoride ion. They concluded that there were no differences between low flow and medium flow anaesthesia in patients with mild renal impairment undergoing prolonged anaesthesia.

11. *Folstein MF,et al Mini-mental state. A practical method for grading the cognitive state of patients for the clinician". Journal of Psychiatric Research 1975*;

They documented the reliability and validity of MMSE in diagnosing depression, psychosis, schizophrenia, mania, personality disorders.

12. *Aldrete JA. The post-anesthesia recovery score revisited. Journal of Clinical Anesthesia 1995; 7: 89-91.*

For more than 25 years aldrete score has been used to assess the status of recovery of patients to discharge the patients from PACU to step down unit or to home. It has accepted as the criteria of choice for discharge the patients from PACU by joint commission of accredition of health care services in may countries like USA.

MATERIALS AND METHODS

The institutional ethical committee approval for the study was obtained. The informed written consent was obtained from the patients participating in the study was obtained. 60 ASA 1 and 2 patients of age 25 to 60 years undergoing elective laparoscopic cholecystectomy surgeries were selected. Patients whose medical history, laboratory data, or physical examination showed evidence of abnormal hepatic or renal function or severe cardiovascular, pulmonary, neurological, psychiatric, ormetabolic disease were excluded from the study. Selected patients were divided randomly into two groups – either to receive low flow sevoflurane anaesthesia (n=30) or to receive medium flow sevoflurane anaesthesia (n=30).

Baseline MMSE scores, VAS score and ramsay sedation scores were recorded from the patients the previous day of the surgery in a quiet room. The criterion for decline in the post operative cognition was the decrease in MMSE score of 2. The above three tests were repeated post operatively by an independent blinded anaesthetist 1hr, 3hrs, 6hrs and 24hrs after extubation.

All the patients participating in the study was pre medicated with inj. glycopyllorate 0.2mg iv. In the operation theatre all basic monitors –

- pulse oximetry,

- NIBP,
- ECG,
- ETCO2 were attached.
- Inspired oxygen concentration was also monitored.

In both the groups patients were pre oxygenated for 3 minutes. Anaesthesia was induced with inj. Fentanyl citrate 2μg/kg, inj. Propofol 2mg/kg and inj. Atracurium 0.9mg/kg IV. After tracheal intubation, anaesthesia was maintained in both groups with O2:N2O 50:50, sevoflurane 1.8- 2% and the fresh gas flow was set to 4l/min. in the low flow group the fresh gas flow was reduced to 1l/min after 10 minutes. The flow rates were set to 500ml/min for both N2O and O2. The flow rate in the medium flow group was maintained at 4l/min and was set to 2l/min for both O2 and N2O. The flow rates of O2 and N2O was adjusted to maintain the inspiratory oxygen concentration at 40% -50% approximately. Ventilation was controlled with a tidal volume of 8 to 10 ml/kg so as to maintain a etco2 of 30 to 35 mm hg.

Sevoflurane concentration was kept constant at 1.8 to 2%. It was decreased only to hypotension or bradycardia not responding to vasopressors and intraoperative fluid loss replacement. The decrease in MAP < 25% or

bradycardia < 50/min was treated with inj. Ephedrine 5mg. The concentration was increased to `control the MAP rise >25% of pre induction value or pulse rate >90/min in response to surgical stimuli. The sevoflurane and the N2O was turned off simultaneously at the last skin suture and the patient was ventilated with 100% oxygen flow of 6l/min until the return of spontaneous ventilation. The trachea was extubated after adequate spontaneous respiratory efforts. The patients received inj. Tramadol 100mg IM at the end of the procedure for post operative pain relief and equal dose was repeated every 12 hrs in the first post operative day.

Emergence times from discontinuation of anesthesia to

- eye opening,
- squeezing fingers,
- spontaneous breathing,
- tracheal extubation,
- recalling name, and
- a modified Aldretes recovery score ≥9 were measured.

Intraoperative and postoperative adverse events or experiences were assessed and recorded.

STATISTICAL ANALYSIS

The information collected regarding all the selected cases were recorded in a master chart. Data analysis was done with the help of computer using **Epidemiological Information Package (EPI 2010)** developed by Centre for Disease Control, Atlanta.

Using this software range, frequencies, percentages, means, standard deviations, chi square, ‘t’ value and 'p' values were calculated. ‘t’ test was used to test the significance of difference between quantitative variables and Yate’s and Fisher’s chi square tests for qualitative variables. A 'p' value less than 0.05 is taken to denote significant relationship.

TABLE 1 : AGE DISTRIBUTION

Group	Age in years		
	Range	**Mean**	**SD**
Low Flow Group	26 - 58	42.0	7.4
Medium Group	29 - 58	40.5	8.1
'p'	0.4573 Not Significant		

The mean age of patients in both groups are compared and it is found to be comparable and statistically not significant.

AGE DISTRIBUTION

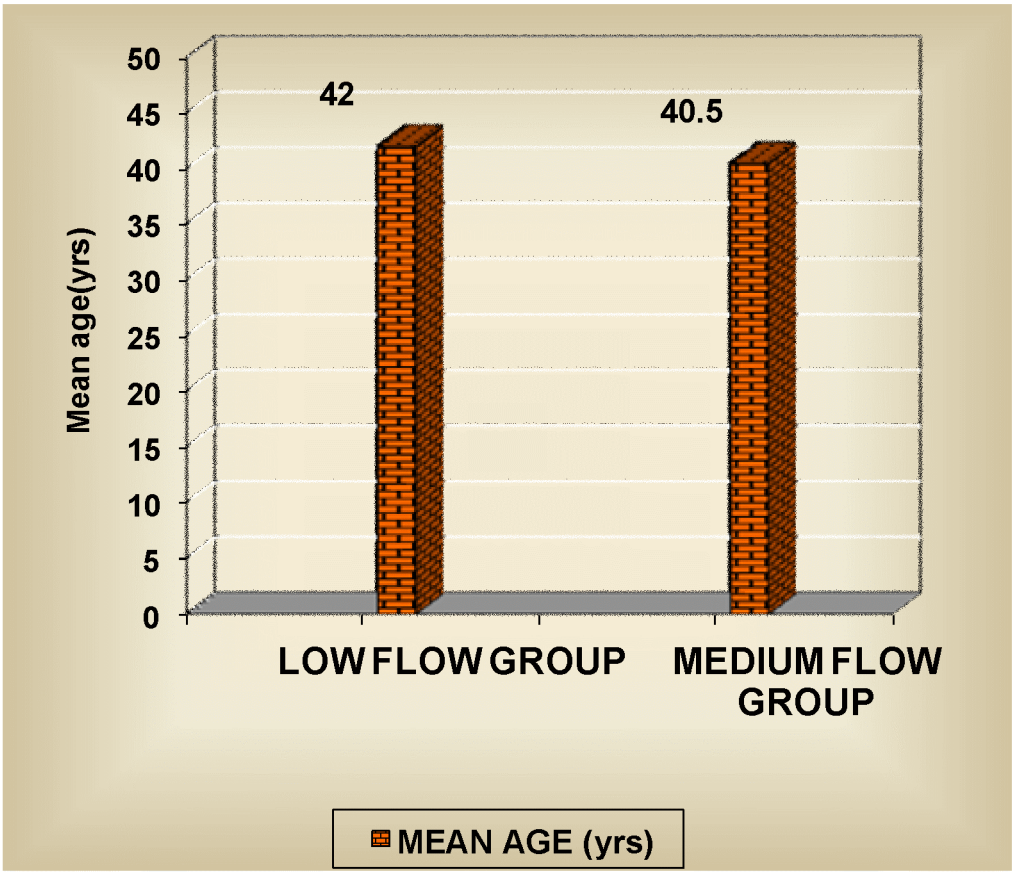


TABLE 2 : SEX DISTRIBUTION

Group	Sex			
	Male		Female	
	No	%	No	%
Low Flow Group	11	36.7	13	43.3
Medium Flow Group	19	63.3	17	56.7
'p'	0.3962 Not Significant			

The sex distribution of both the groups are compared and is found to be statistically insignificant

SEX DISTRIBUTION

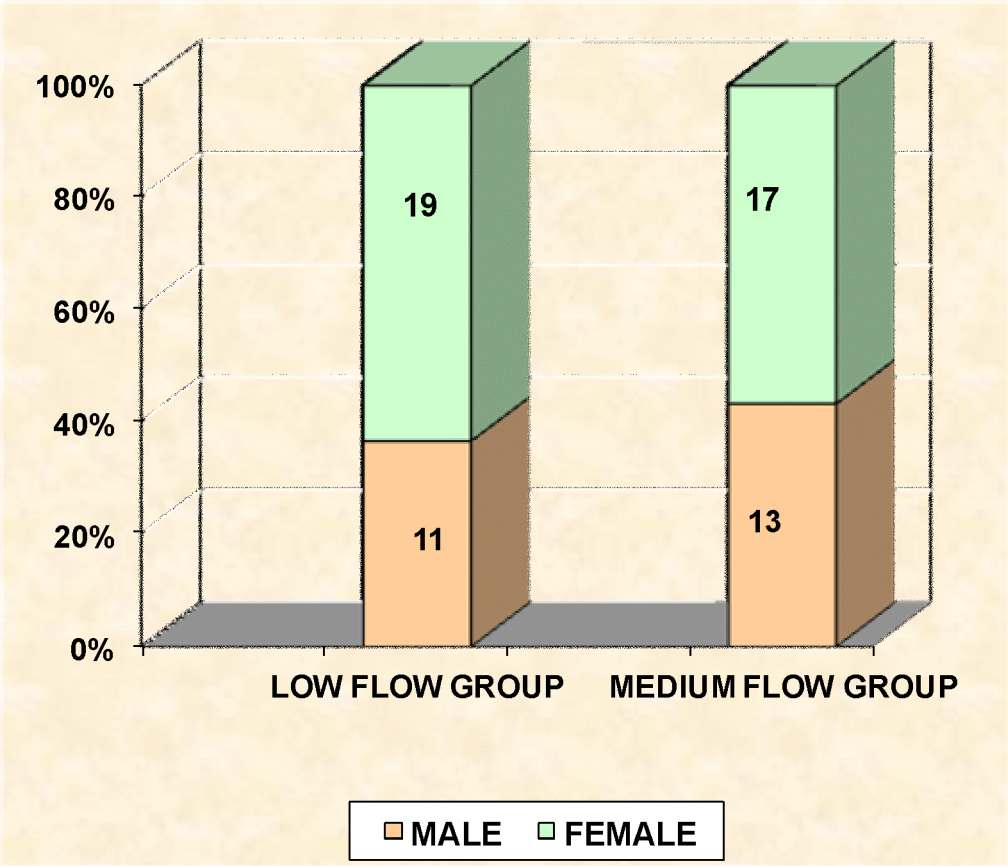


TABLE 3 : WEIGHT

Group	Weight (Kg)		
	Range	**Mean**	**SD**
Low flow group	50 - 75	62.0	5.7
Medium flow group	50 - 72	62.1	5.8
'p'	0.9468 Not significant		

The weight of the patients in both the groups are compared and found to be statistically not significant.

WEIGHT

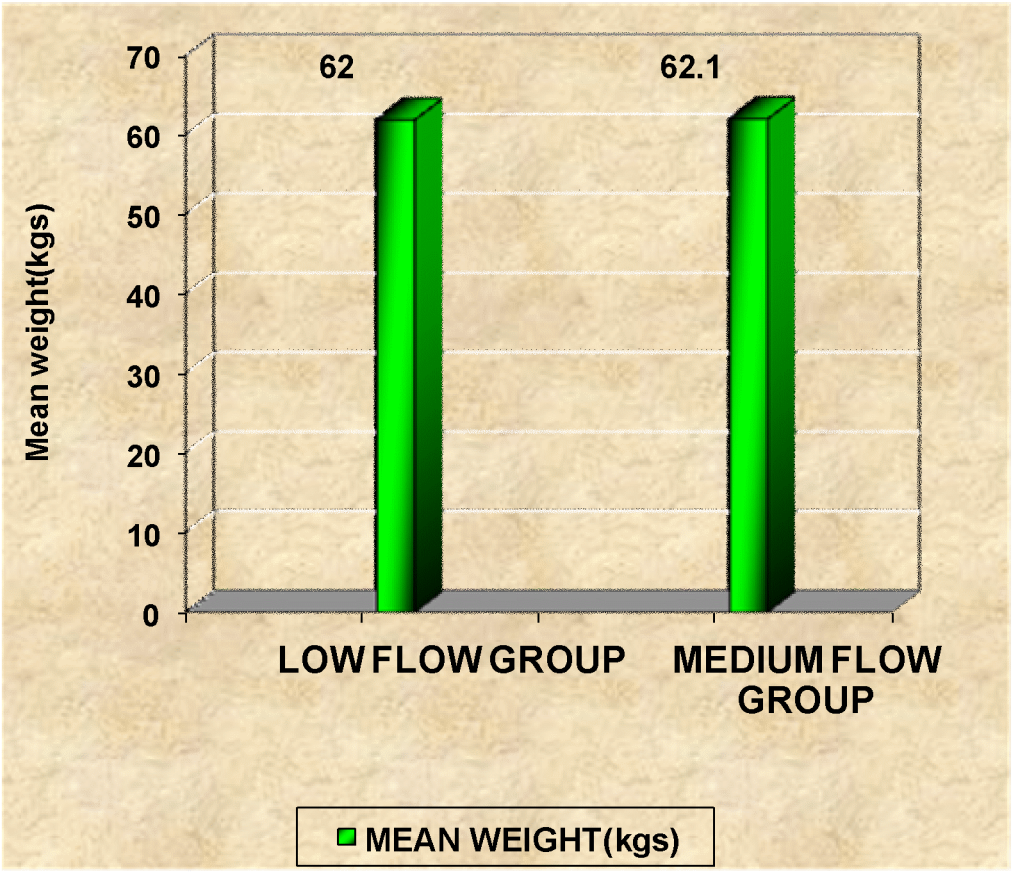

70
60
50
40
30
20
10
0
Mean weight(kgs)
62
62.1
LOW FLOW GROUP
MEDIUM FLOW GROUP
MEAN WEIGHT(kgs)

TABLE 4 : A S A

Group	ASA			
	1		2	
	No	%	No	%
Low flow group	13	43.3	17	56.7
Medium flow group	17	56.7	13	43.3
'p'	0.2195 Not significant			

The ASA physical status of both the groups are compared and found to be statistically not significant.

ASA GRADE

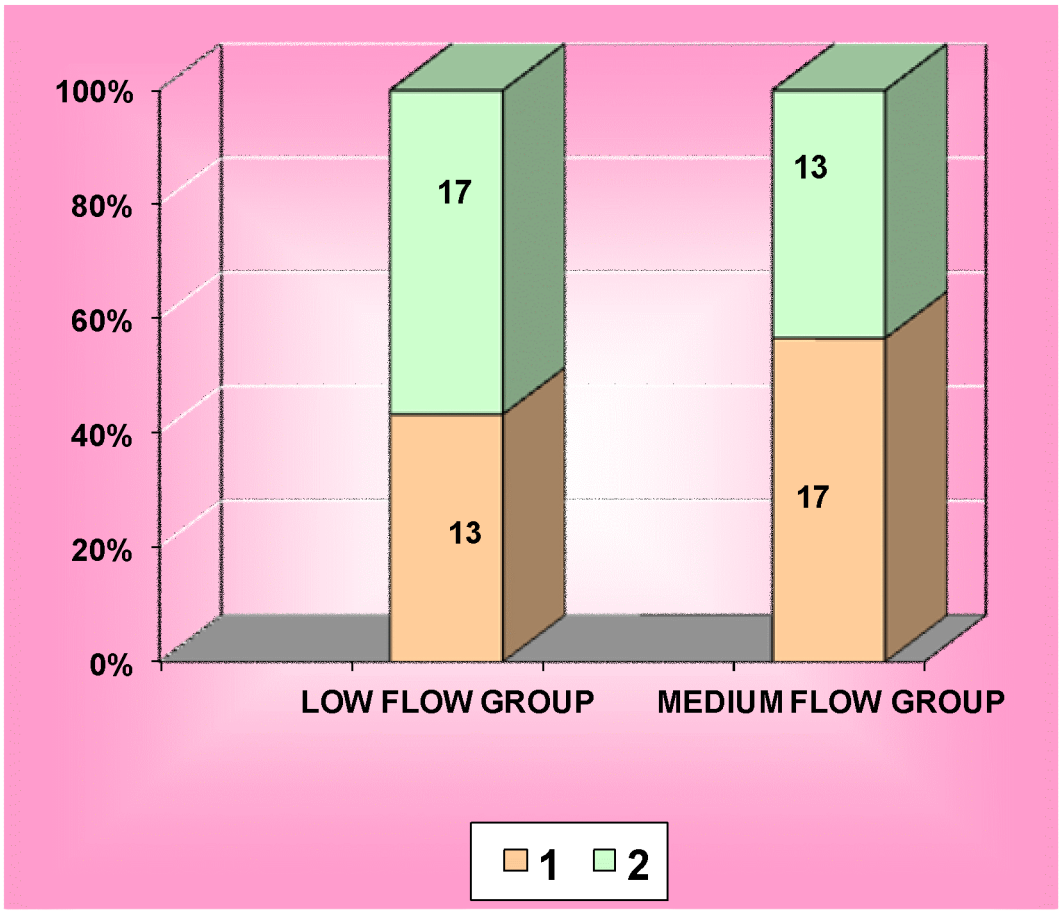


TABLE 5 : SURGERY TIME

Group	Surgery Time (minutes)		
	Range	**Mean**	**SD**
Low flow Group	40 - 80	57.1	10.7
Medium flow Group	40 - 85	62.1	11.5
'p'	0.0836 Not Significant		

The total duration of the surgery is compared and found to be statistically insignificant

SURGERY TIME

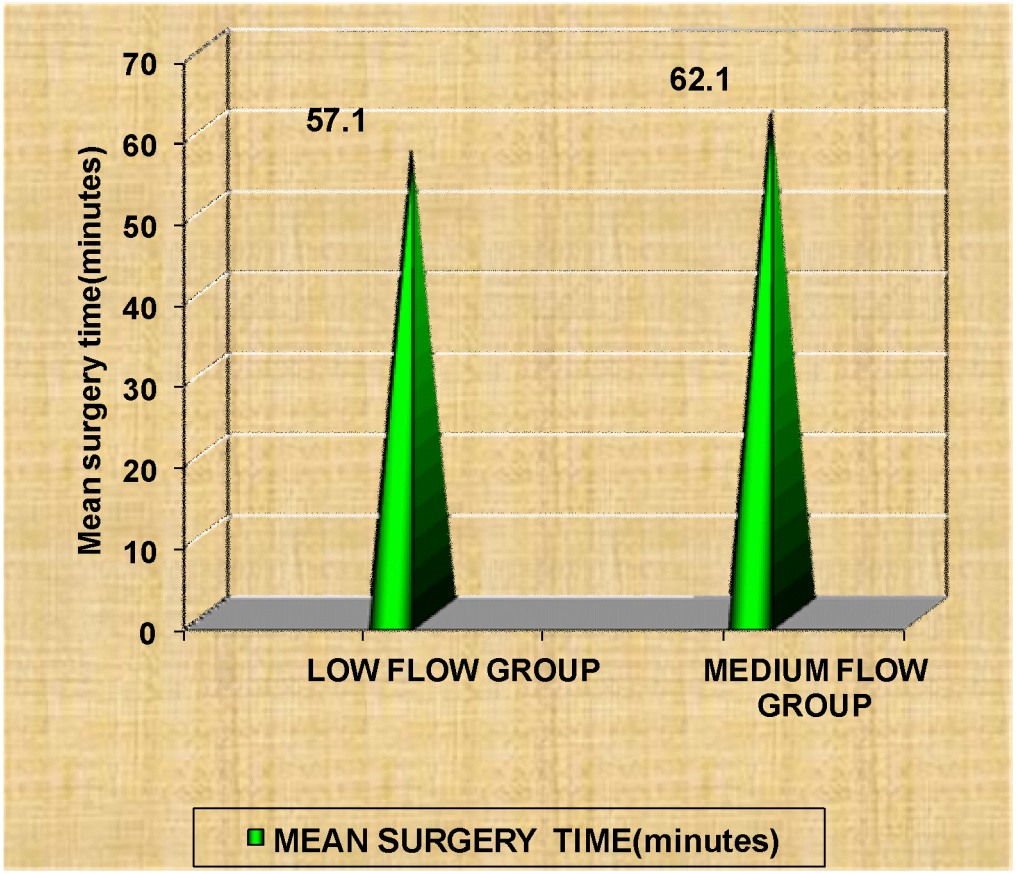
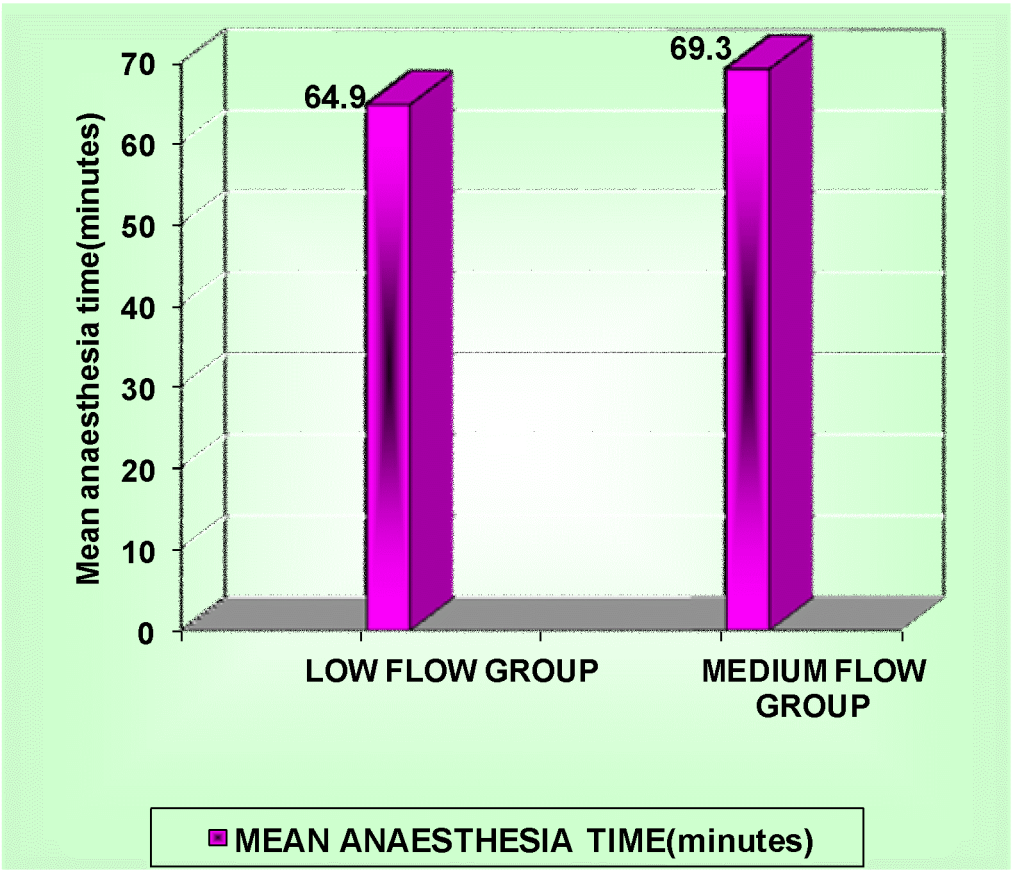


TABLE 6: ANAESTHESIA TIME

Group	Anaesthesia Time(minutes)		
	Range	**Mean**	**SD**
Low flow Group	46 - 89	64.9	10.9
Medium flow Group	48 - 92	69.3	10.4
'p'	0.1211 Not Significant		

The total duration of anaesthesia is compared and found to be statistically insignificant.

ANAESTHESIA TIME



RECOVERY CRITERIA

TABLE 7 : EYE OPENING

Group	Eye opening (minutes)		
	Range	**Mean**	**SD**
Low flow Group	3 - 16	7.79	3.54
Medium flow Group	4 – 17.5	8.24	3.53
'p'	0.6235 Not Significant		

The time taken for eye opening after discontinuation of sevoflurane is compared and found to statistically insignificant.

EYE OPENING

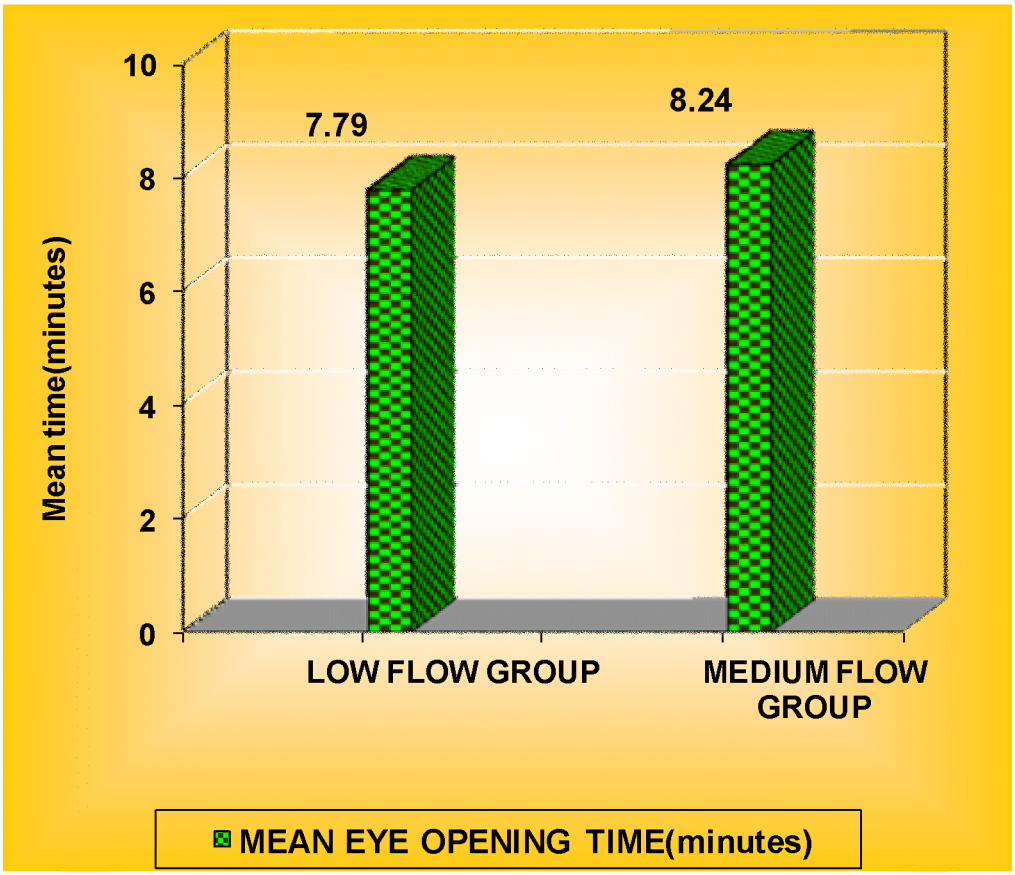

10
8
6
4
2
0
Mean time(minutes)
7.79
8.24
LOW FLOW GROUP
MEDIUM FLOW GROUP
MEAN EYE OPENING TIME(minutes)

TABLE 8 : SQUEEZING FINGERS

Group	Squeezing Fingers (minutes)		
	Range	**Mean**	**SD**
Low flow Group	5 - 22	11.8	3.8
Medium flow Group	6.5 - 20	10.8	3.8
'p'	0.3237 Not Significant		

The time taken for squeezing fingers after discontinuation of anaesthesia is compared and found to be statistically insignificant.

SQUEEZING FINGERS

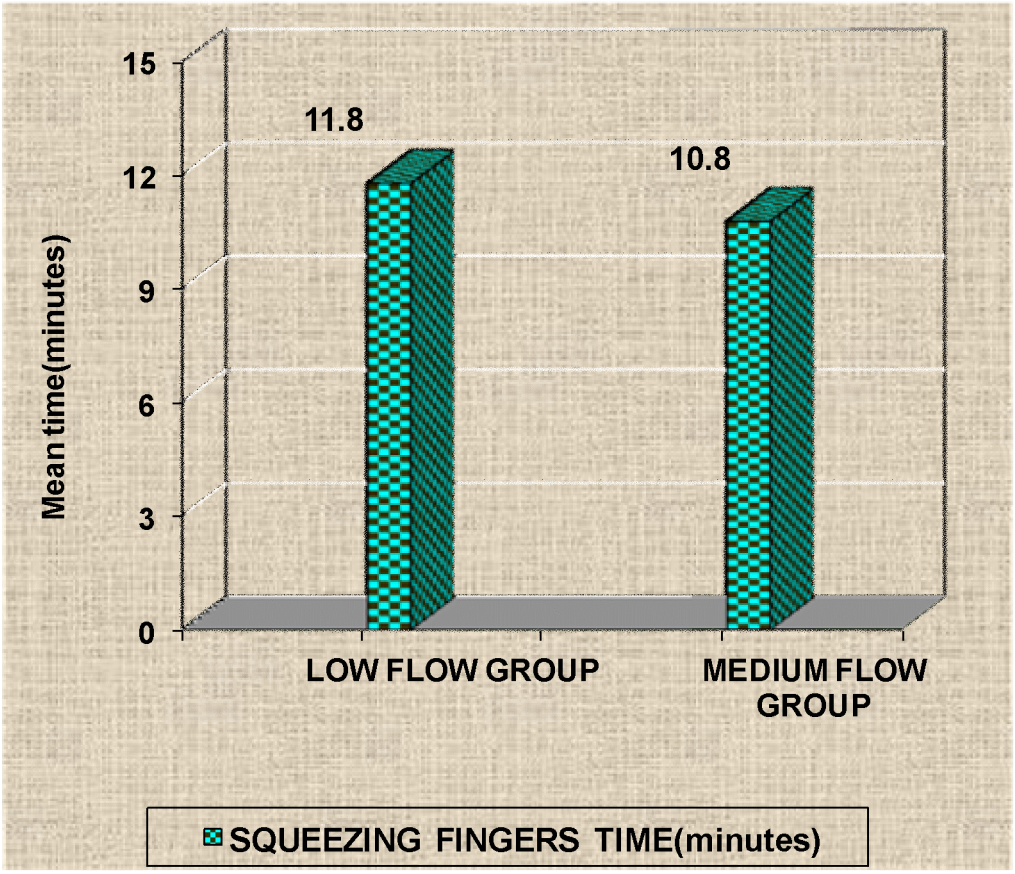


TABLE 9 : SPONTANEOUS BREATHING

Group	Spontaneous Breathing (minutes)		
	Range	**Mean**	**SD**
Low flow Group	2 - 11	4.23	2.17
Medium flow Group	2 - 10	4.43	1.79
'p'	0.6986 Not Significant		

The time taken for the return of spontaneous breath after discontinuation of anaesthesia are compared and found to be statistically not significant.

SPONTANEOUS BREATHING

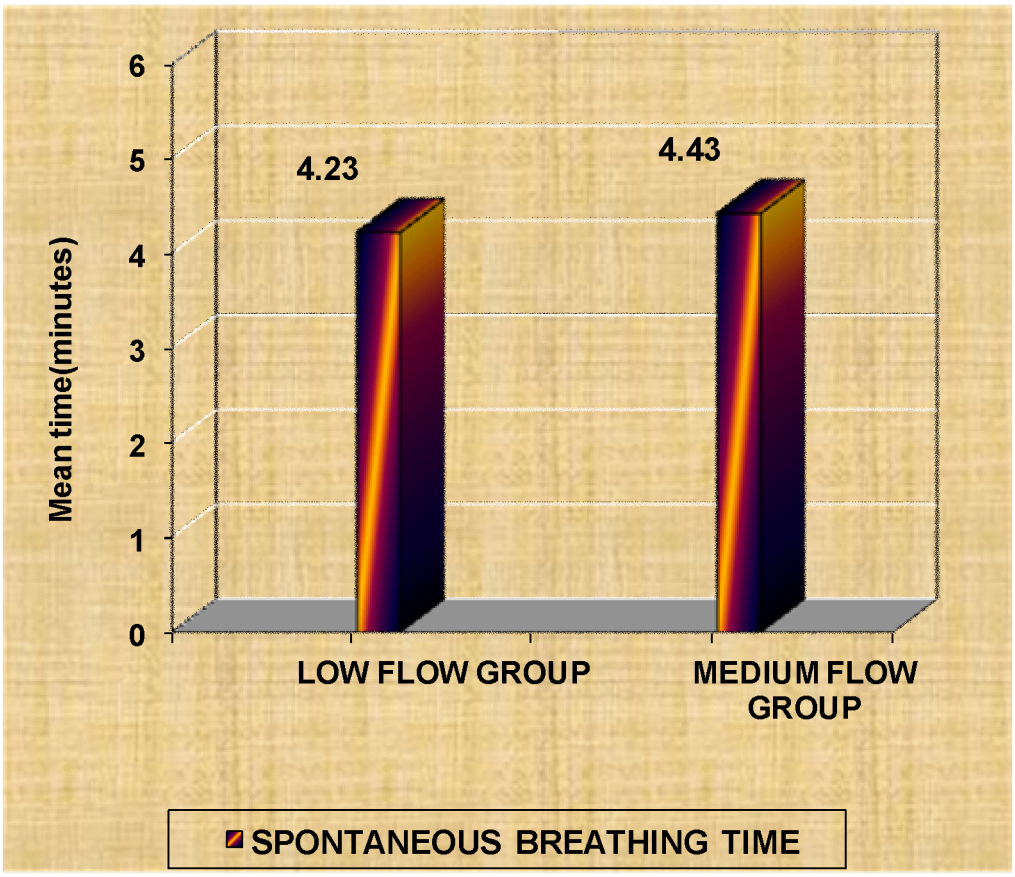


TABLE 10 : EXTUBATION

Group	Extubation (minutes)		
	Range	**Mean**	**SD**
Low flow Group	3.5 – 15.5	7.28	2.82
Medium flow Group	4.5 - 16	7.82	3.21
'p'	0.4974 Not Significant		

The time taken for extubation after discontinuation of anaesthesia is compared and is found to be statistically not significant.

EXTUBATION

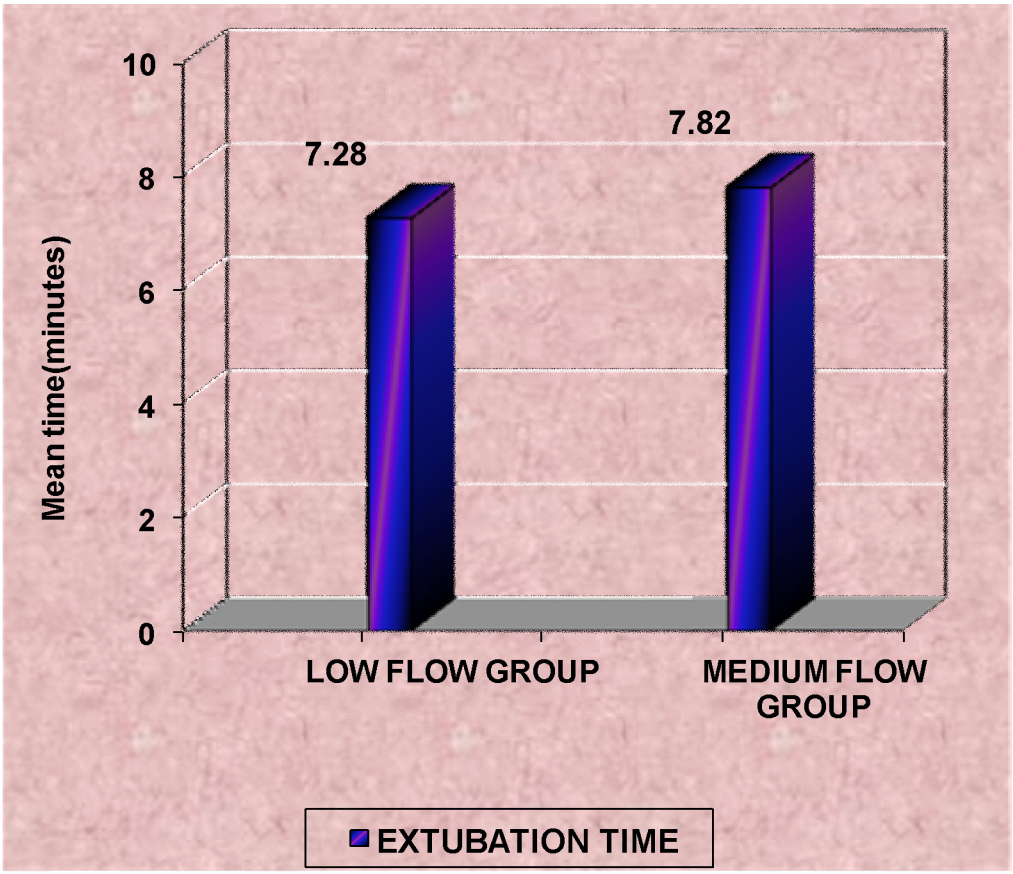

10
8
6
4
2
0
Mean time(minutes)
7.28
7.82
LOW FLOW GROUP
MEDIUM FLOW GROUP
EXTUBATION TIME

TABLE 11: RECALLING NAME

Group	State Name (minutes)		
	Range	**Mean**	**SD**
Low flow Group	4 – 16.5	9.47	3.18
Medium flow Group	5 - 18	10.23	3.57
'p'	0.3832 Not Significant		

The time taken for the patients to recall their name is compared and found to be statistically insignificant.

RECALLING NAME

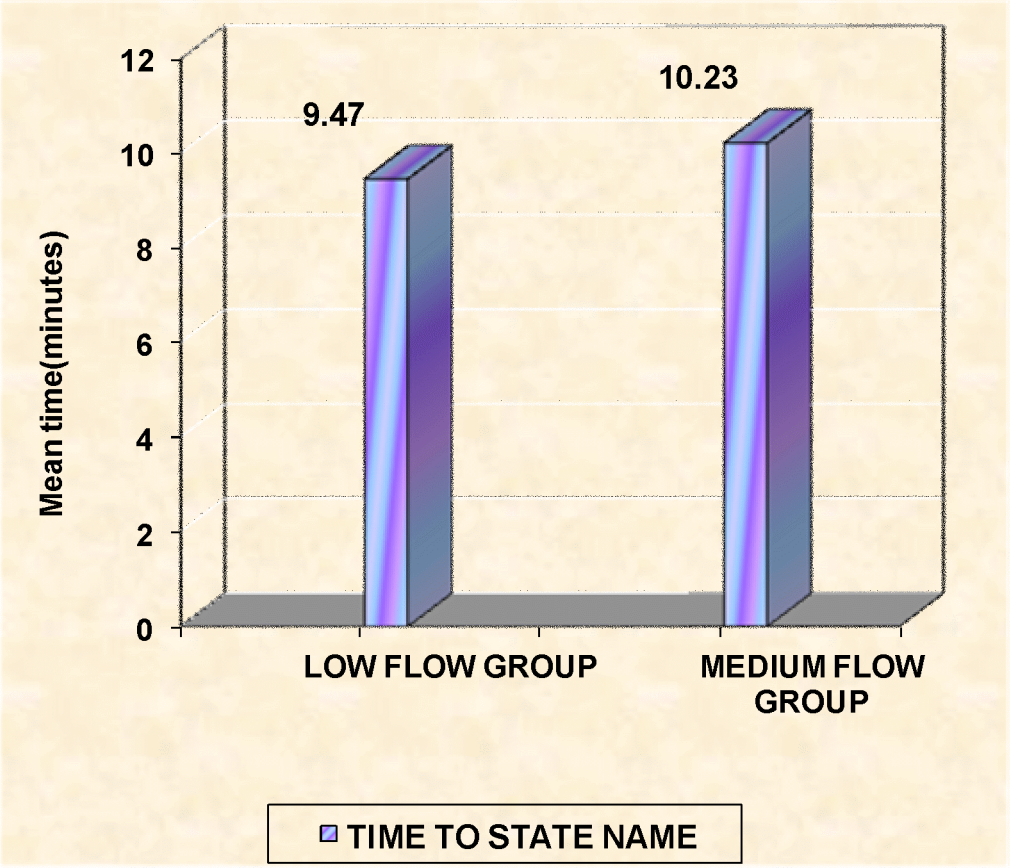


TABLE 12 : RECOVERY TIME

Group	Recovery Time (minutes)		
	Range	**Mean**	**SD**
Low flow Group	9 - 24	13.9	3.5
Medium flow Group	9 - 23	13.8	3.6
'p'	0.9572 Not Significant		

The time taken for the achieving aldrete score >9 is compared and found to be statistically insignificant.

RECOVERY TIME

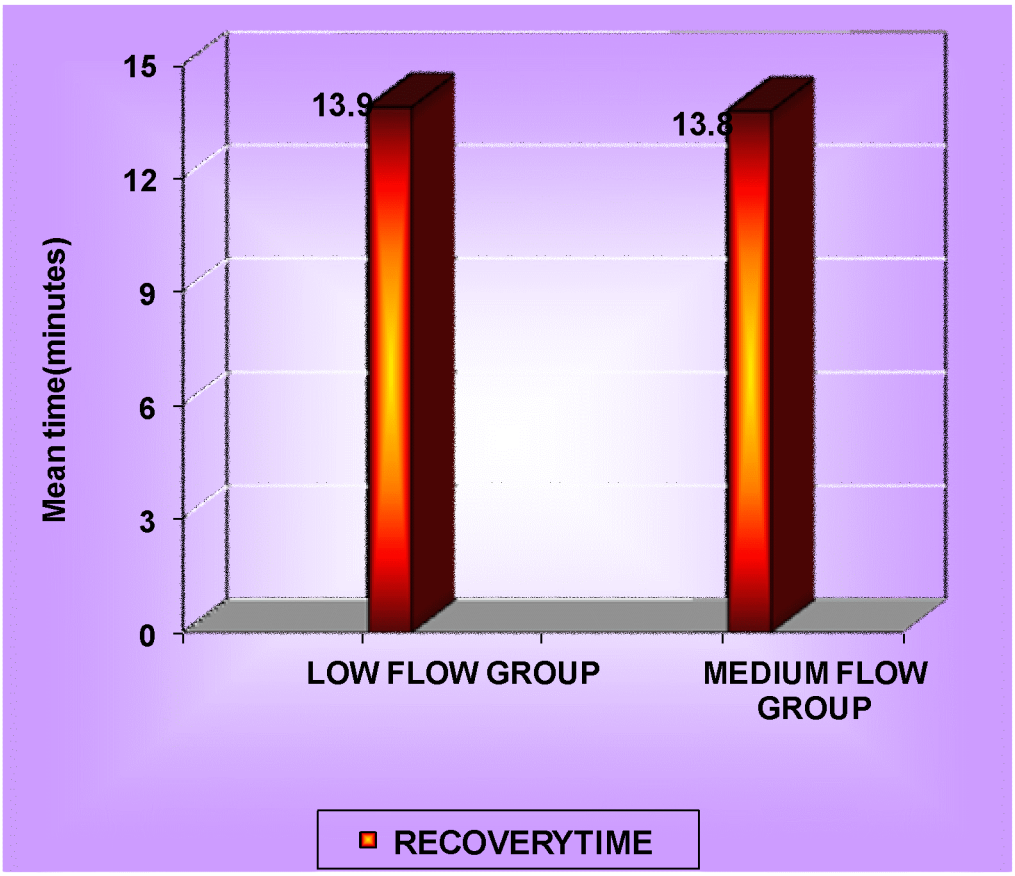


TABLE 13: CHANGES IN FIO2

FIO2 at	FIO2 of				'p'	Significant
	Low flow Group		Medium flow Group			
	Mean	SD	Mean	SD		
5 minutes	52.2	2.8	52.6	2.2	0.5043	Not Significant
15 minutes	44..7	1.6	44.5	1.5	0.6098	Not Significant
30 minutes	44.5	1.5	44.3	1.5	0.6038	Not Significant
45 minutes	44.2	1.3	44.1	1.3	0.7631	Not Significant
60 minutes	45.8	9.3	48.4	12.8	0.4194	Not Significant
75 minutes	76.3	22.8	69.4	20.7	0.6036	Not Significant
90 minutes	-	-	79.3	18.5	-	Not Significant

The fraction of inspired oxygen is adjusted to maintain between 40-50% throughout the procedure

CHANGES IN FIO2

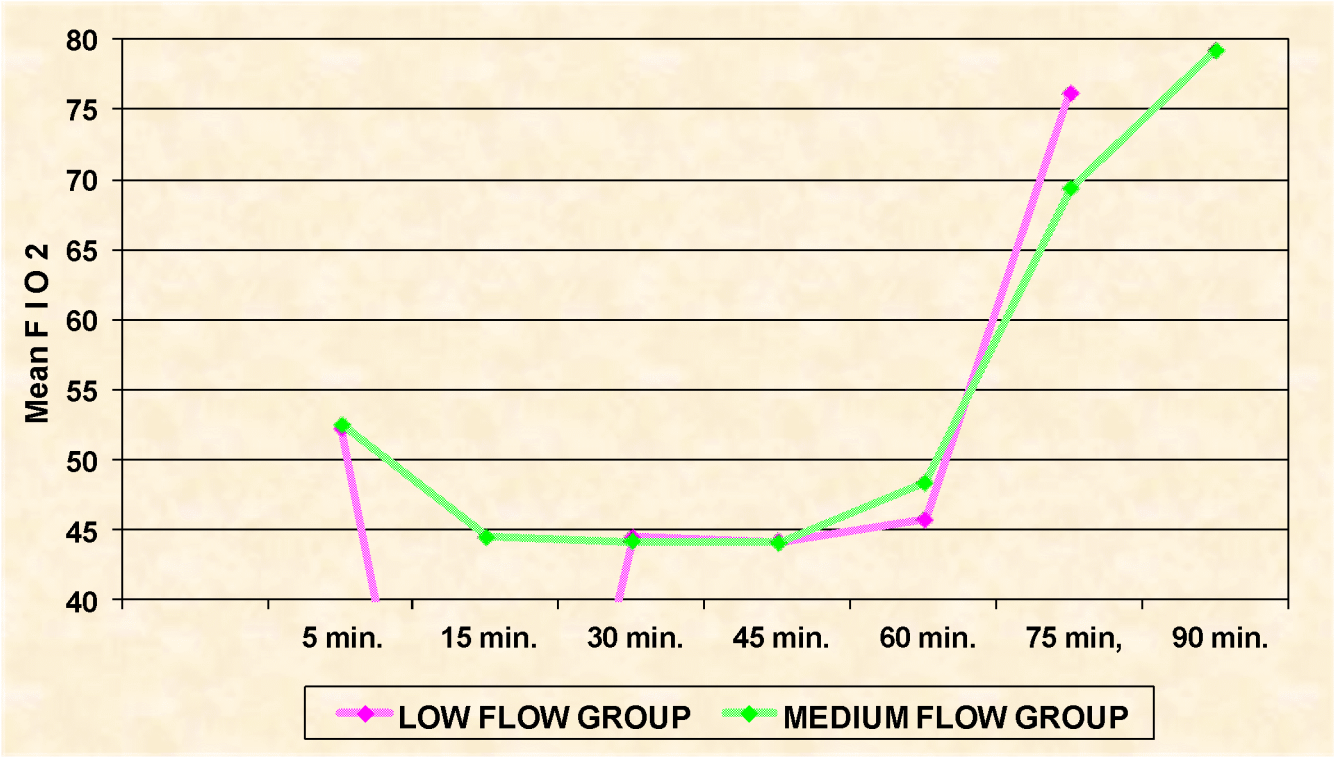


TABLE 14 : CONC. OF SEVOFLURANE

Conc. of sevoflurane at	Conc. of sevoflurane of				'p'	Significant
	Low flow Group		Medium flow Group			
	Mean	SD	Mean	SD		
5 minutes	2.0	-	2.0	-	-	-
15 minutes	2.18	0.36	2.17	0.36	0.8573	Not Significant
30 minutes	2.13	0.32	2.12	0.31	0.8391	Not Significant
45 minutes	2.0	-	2.02	0.09	0.3215	Not Significant
60 minutes	2.0	-	2.0	-	-	-
75 minutes	2.0	-	2.0	-	-	-
90 minutes	-	-	-	-	-	-

The concentrations of sevoflurane in both the groups are compared throughout the procedure and found to be statistically insignificant.

CONCENTRATION OF SEVOFLURANE

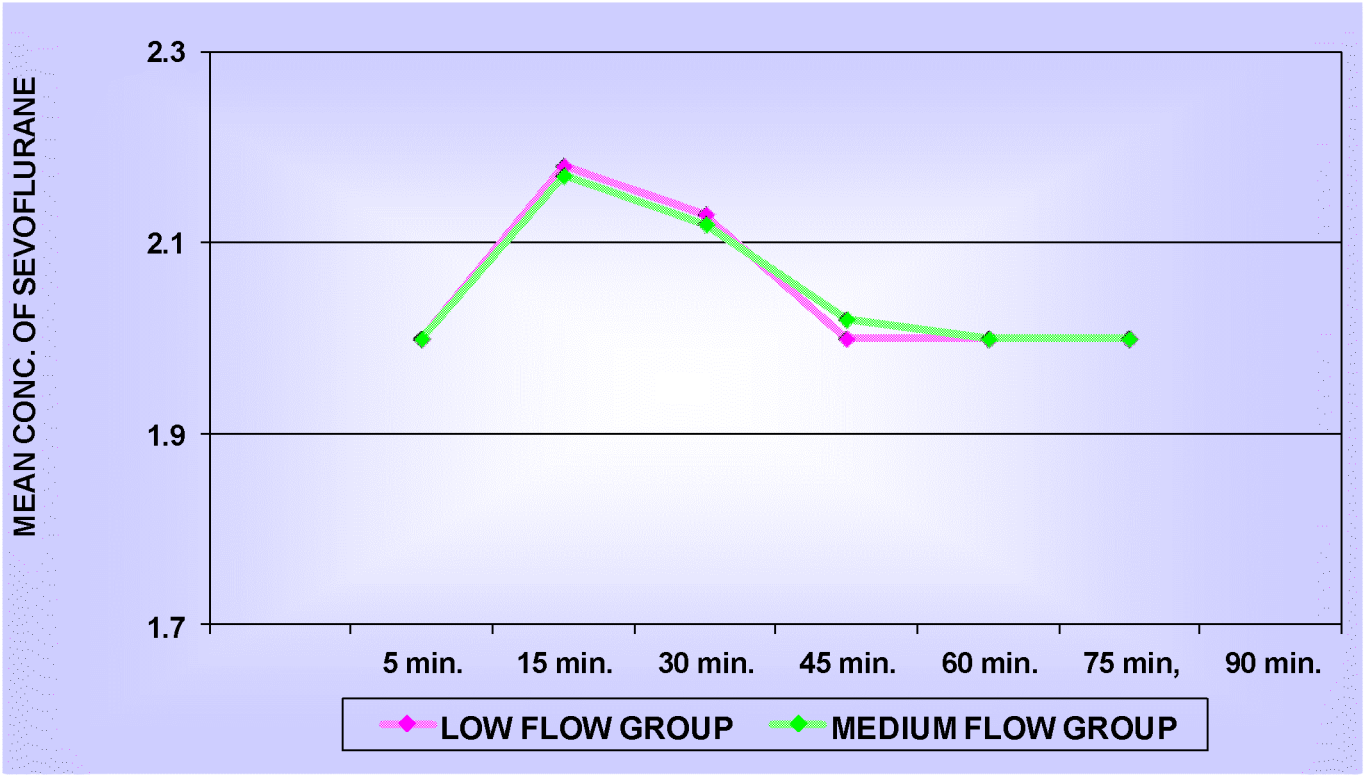


TABLE 15 : VAS

VAS at	VAS for				'p'
	Low Flow Group		Medium Flow Group		
	Mean	SD	Mean	SD	
Baseline	3.4	0.89	3.53	0.75	0.462 Not Significant
1 hour	2.13	0.57	2.33	0.66	0.2149 Not Significant
3 hours	2.5	0.57	2.57	0.5	0.6339 Not significant
6 hours	3.4	0.81	3.4	0.56	0.9601 Not significant
24 hours	5.1	0.76	5.0	0.79	0.6185 Not Significant

No significant differences noted in the VAS scores in both the groups in the first 24 hours.

TABLE 16: SEDATION SCORE

Sedation Score at	Sedation Score of				'p'
	Low Flow Group		Medium Flow Group		
	Mean	SD	Mean	SD	
Baseline	4.9	0.31	4.83	0.38	0.456 Not Significant
1 hour	2.8	0.76	2.93	0.74	0.4941 Not Significant
3 hours	4.57	0.5	4.23	0.5	0.13 Not Significant
6 hours	4.93	0.25	4.93	0.25	1.0 Not significant
24 hours	4.97	0.18	5.0	0.26	0.5703 Not Significant

No significant difference noted in the sedation scores in both groups in the first 24 hours post operatively.

TABLE 17 : MMSE

MMSE at	MMSE of				'p'
	Low Flow Group		Medium Flow Group		
	Mean	SD	Mean	SD	
Baseline	26.1	0.8	26.4	0.77	0.18 Not Significant
1 hour	24.8	1.8	25.4	1.2	0.118 Not Significant
3 hours	26.0	1.5	26.4	1.1	0.2502 Not significant
6 hours	26.3	1.4	26.9	1.0	0.0592 Not significant
24 hours	26.7	1.1	27.0	1.9	0.4589 Not Significant

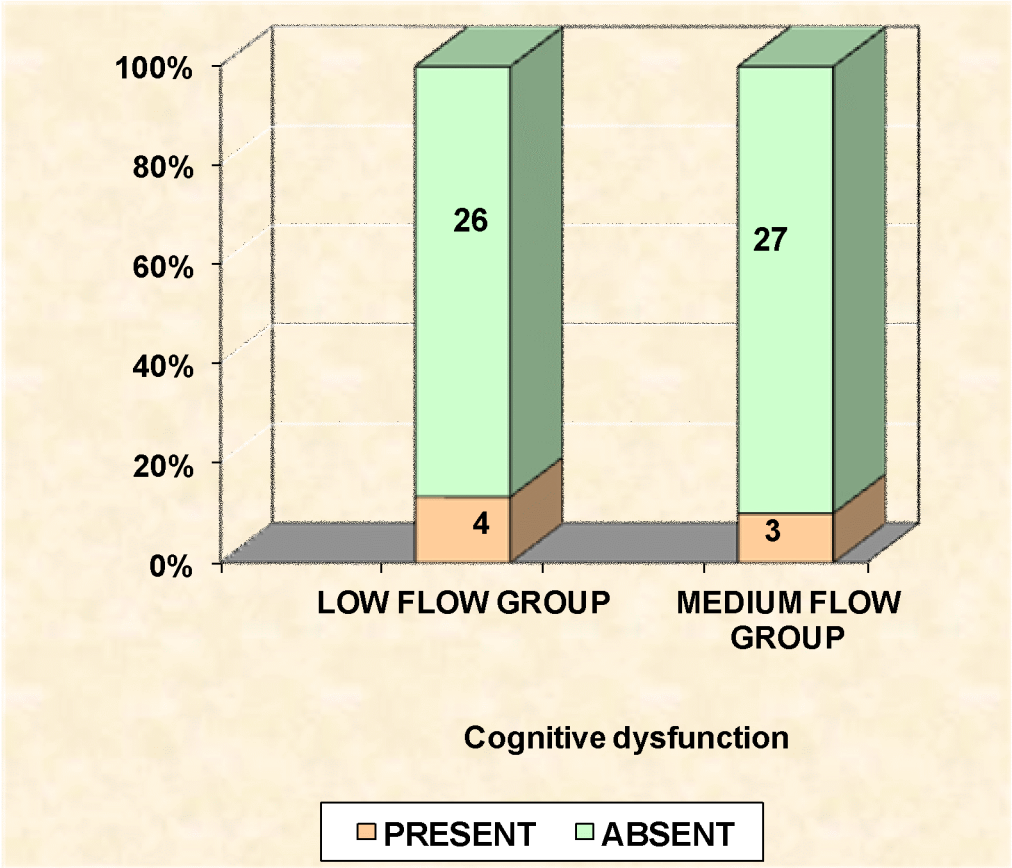
No significant differences in the MMSE scores in the first 24 hours post operatively.

TABLE 18: COGNITIVE DYSFUNCTION

Group	Cognitive dysfunction	
	No.	**%**
Low flow Group	4	13.3
Medium flow Group	3	10
'p'	0.5 Not Significant	

13.3% of the individuals in the low flow group and 10% of the individuals in the medium flow group is found to have cognitive dysfunction in the 1st hour post operatively. This difference is statistically insignificant.

COGNITIVE DYSFUNCTION



RESULTS

Both the groups low flow group and medium flow group did not differ significantly in demographic data. The duration of surgery, anesthesia time also had no significant difference. Dial settings kept to maintain adequate depth of anaesthesia also had no significant difference. Emergence recovery criteria (ie) the time taken to open eyes, squeeze fingers, extubation, recalling name and the time taken for aldrete score >9 also had no significant difference between the low flow and the medium flow group. Also the VAS score for assessing pain did not vary significantly between the two groups recorded both pre operatively, and at 1hr, 3 hrs, 6 hrs, 24 hrs after discontinuation of anaesthesia. The sedation score assessed by ramsay sedation score showed no significant difference between the two groups both pre operatively.

MMSE score was used in our study to assess the cognitive function. The decrease in score >2 when compared to baseline was the criteria to define post operative cognitive dysfunction. 4 (13.3%) patients in the low flow group and 3 (10%) patients in the medium flow group had decrease in the 1st hr MMSE score more than 2 when compared to baseline score. There were no significant difference between the MMSE scores of patients in both the groups.

There were no significant difference between the patients of two groups in having adverse events like nausea or vomiting. Two patients in medium flow group and one in low flow group had nausea and vomiting treated accordingly. All patients had uncomplicated post operative course.

DISCUSSION

Cognitive dysfunction has been defined as the impairment of memory, concentration, ability to processing the facts and planning for the future. Post operative cognitive dysfunction is dependent on various factors like type of surgery and anaesthesia, duration of anesthesia, age of the patient, anaesthetic agent used and no. of repeated surgeries. Post operative cognitive dysfunction causes a delay in the early discharge of patients which is very important in laparoscopic surgeries. The incidence of POCD calculated to be 3.5-45% according to a study at 24 hrs after surgery.

The post operative cognitive dysfunction also dependent on the type of anaesthesia used and the drugs used. Anaesthetic agents causing post operative cognitive dysfunction due to the residual anaesthetic agent present in higher centres of the brain post operatively. It follows that the agents which have a short elimination half life had a less effect on cognitive function. The volatile agents to cause least cognitive dysfunction it must be eliminated from the body soon (ie) it must have poor solubility or low blood gas coefficient. So the choice of volatile agents for day care surgeries are desflurane or sevoflurane.

In this study we used mini mental state examination score for assessing the patients cognitive function. It is reliable, valuable in assessing the patients

with schizophrenia, mania, depression, personality disorders. It take less than 10 minutes to assess the patients with this score. It can be easily used in patients in supine position post operatively. It can be used repeatedly. It is commonly used in psychiatric examination to assess dementia. The total score of MMSE score is 30. The criteria used to define cognitive decline was the reduction in score> 2 when compared to the baseline.

The results of various studies regarding post operative cognitive dysfunction had resulted in conflicting results. Many studies compared the recovery and cognitive function of patients receiving sevoflurane and desflurane. However they concluded that the immediate recovery may be earlier with desflurane but the cognitive function post operatively was similar with desflurane and sevoflurane. Chen and collegues also used MMSE score to assess post operative cognitive dysfunction. They also concluded that the immediate recovery was early in desflurane group but the return of cognitive function was similar with sevoflurane and desflurane. But the same workers also reported a decrease in the cognitive scores 1 hour post operatively in patients received sevoflurane anaesthesia for more than three hours. It follows that the decrement in cognitive function was due to longer duration of anaesthesia. In our study the duration of anaesthesia was ninety minutes. Bailey and colleagues showed that

the 90% decrement times of sevoflurane was of little difference for the first 90 minutes, it increased to a greater extent after that.

It is well known that the consumption of inhalation agent was less in low flow anaesthesia resulting in the economic use of inhalation agents. This fact has been documented by various studies. But the low flow anaesthesia with sevoflurane was a controversy due to the formation of degaradation products like compound A which proved to be nephrotoxic in animal studies. These observations had led to the doubt of safety of sevoflurane in low flow anaesthesia. Our study shows that there is no difference in recovery and cognitive function in patients receiving low flow or medium flow anaesthesia. It confirms that the fresh gas flow has no effect on the post operative cognitive function. Also the sevoflurane being rapid and short acting, have low solubility (ie) low blood gas coefficient, will have little or nil residual effects on the cognitive function or recovery. Also in both groups at the end of the procedure the high flow oxygen(6l/min). Therefore the decrement times of sevoflurane was same in both the groups. The results of our study is in confirmation with the study Bunyamin Muslu and his colleagues who reported 17% and 11% of patients with cognitive dysfunction in low flow group and medium flow group and no difference in recovery times between the two groups . Our study had 4 patients in low flow group and 3 in medium flow group with cognitive decline at

1 hr after surgery. No difference was noted in the recovery times between the two groups.

The limitations of our study are that the duration of anaesthesia in the study was about 90 minutes. The effects of prolonged anaesthesia could not be commented. Also only the adult patients were enrolled in the study. Comment could not be made on the effect on pediatric population.

CONCLUSION

We conclude that the fresh gas flow have no effect on the post operative cognitive function and recovery times in patients undergoing sevoflurane anaesthesia for elective laparoscopic cholecystectomy surgeries.

SUMMARY

Our study was a prospective randomized study including 60 patients undergoing elective cholecystectomy surgeries. They were randomly divided into two groups each of 30 either to receive low flow or medium flow anaesthesia. Anaesthetic premedication and induction were standardized for both the groups. During maintenance the low flow and medium groups were to receive 1l/min or 4l/min of fresh gas flow respectively. Both the groups were maintained with 1.8 to 2% sevoflurane depending on the depth of anaesthesia determined by the hemodynamics. The reversal was standardized in both the groups.

The parameters monitored were the baseline and post operative MMSE scores, VAS score and RAMSAY sedation score at 1hr,3 hr, 6 hrs, and 24 hrs, the time taken for recovery at the emergence. The hemodynamic parameters, ETCO2, FIO2 were monitored intraoperatively. The reduction in the MMSE score of more than 2 compared to baseline was the criterion to define cognitive decline post operatively.

We found that there was no significant difference in the recovery times between the two groups viz low flow and medium flow group. There were no

significant difference between the two groups in the post operative VAS and the ramsay sedation scores. 4 persons in the low flow group and 3 in the medium flow group had cognitive decline at 1 hour post operatively. This was not statistically significant. There were also no difference in the intra operative hemodynamics in both the groups.

We therefore conclude that the fresh gas have effect on the post operative cognitive function and the recovery in the patients undergoing sevoflurane anaesthesia for laparoscopic cholecystectomy surgeries.

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PROFORMA

Name : I.P.No:

Age & Sex: ASA:

Weight :

Date &Time of Admission:

Diagnosis:

Procedure:

History: H/O CVS,RS Comorbidity
H/O Neurological Illness
H/O Psychiatric Illness
H/O Alcohol Intake
H/O Drug Intake

PRE-OPERATIVE PERIOD:(RECORDED DAY BEFORE SURGERY)

PARAMETERS	SCORE
VAS SCORE	

SEDATION SCORE	
MMSE SCORE	

INTRA OPERATIVE MONITORING(TO BE DONE EVERY 15 MIN)

PARAMETERS	15 min	30 min	45 min	60 min	75 min	90 min	105 min
PULSE RATE							
NIBP							
SPO2							
ETCO2							
FIO2							
TEMPERATURE							
ECG							
CONC. OF SEVOFLURANE							

POST OPERTIVE RECOVERY

PARAMETERS	TIME IN MINUTES
EYE OPENING	
SQUEEZING FINGERS	

SPONTANEOUS BREATHING	
EXTUBATION	
RECALL NAME	
ALDRETE SCORE (>9)	

POST OPERATIVE FOLLOW UP

PARAMETERS	1 HR	3 HR	6 HRS	24 HRS
VAS SCORE				
SEDATION SCORE				
MMSE SCORE				

Low flow group

S.No.	Patient name	age	weight	sex	asa	surgery time	anaesthesia time	eye opening	Squeeze fingers	Spontaneous breathing	Extubation	State name	recovery time(>9)	VAS Base line	1 hr	3hrs	6hrs	24 hrs	SEDATION Base line	1 hr	3 hr	6hrs	24 hrs	MMSE Base line	1 HR	3 HRS	6 HRS	24 HRS
1	dhanam	45	58	F	2	55	63	10	14	5	9	13	15	5	2	2	4	4	5	2	4	5	5	26	25	26	27	28
2	pandeeswari	52	65	F	2	60	67	8	13.5	3	6	12	14	4	2	3	3	5	5	2	4	5	5	25	22	25	25	26
3	banu	36	70	F	2	68	75	7	10	3.5	7	8	12	3	2	3	3	5	5	2	4	5	5	26	25	26	26	26
4	anushree	29	54	F	1	58	65	3	6	2	3.5	4	9	4	2	3	3	5	5	4	5	5	5	28	28	28	29	29
5	arumugam	58	60	M	2	45	53	15	22	11	15.5	16	24	3	3	3	3	5	5	2	4	4	4	24	20	22	23	24
6	sooriyan	48	58	M	1	62	70	9	15	6.5	8	10	16	5	2	2	5	5	5	3	4	5	5	26	24	26	26	27
7	sita	44	65	F	1	50	69	6	10	4	5.5	8	12	4	2	2	5	6	5	3	5	5	5	26	24	26	27	27
8	ramarajan	40	75	M	1	55	64	4	7	2.5	5.5	6	10	2	3	2	4	5	4	3	4	5	5	26	25	26	26	26
9	mohan	39	50	M	1	63	70	6	9.5	3.5	6	7.5	11	3	3	2	3	6	5	4	5	5	5	27	26	27	27	27
10	gandhi	49	60	M	2	80	89	10	15	6	9	13	16.5	3	3	3	5	6	5	2	5	5	5	26	25	26	26	26
11	marimuthy	32	65	M	1	40	46	4	9	2	4.5	7	10	4	2	3	3	5	5	3	5	5	5	27	27	28	28	28
12	raasu	36	62	F	1	65	74	5	9	2	3.5	6.5	12	4	1	2	4	6	5	4	5	5	5	26	26	26	26	26
13	devi	50	60	F	2	60	70	9	15.5	4.5	7	10	13	2	2	2	3	6	5	2	5	5	5	25	22	22	23	25
14	dhanya	48	58	F	2	67	75	7	12	3	7.5	9	13.5	4	2	2	4	5	5	3	5	5	5	26	25	26	26	27
15	sriram	31	64	M	1	50	58	4.5	9	2	4	7.5	10	2	1	2	4	6	4	4	4	5	5	28	27	28	28	28
16	maheshwari	38	70	F	2	45	53	6	9	4	5.5	6.5	12	3	2	2	2	5	5	2	4	5	5	26	26	27	27	27
17	maareswaran	43	64	M	2	40	48	8	13.6	4.5	9	10	14	3	2	2	3	4	5	3	4	5	5	26	25	26	26	26
18	mukunth	49	68	M	2	60	70	8.5	12	3.5	8	10	15	3	3	3	3	5	5	3	5	5	5	26	22	24	24	25
19	aruljothy	51	58	F	2	65	72	13	18.5	10	14.5	16.5	19	4	1	3	3	5	5	3	5	5	5	25	21	23	25	25
20	sathyajothy	33	65	F	1	75	82	5	9	3	6.5	7	12	3	2	3	3	5	5	4	5	5	5	26	25	26	26	27
21	sahayamary	44	60	F	2	45	52	9.5	14	5	9	10	18	2	2	4	3	6	5	2	5	5	5	27	25	27	27	27
22	joseph	47	70	M	2	45	53	16	16	5	9	13.5	20	4	3	2	2	5	5	3	4	5	5	26	25	26	26	26
23	sekar	40	64	M	2	60	68	7	12	4	8	10	14	3	2	2	4	6	5	2	5	4	5	26	24	27	27	27

24	rekha	43	58	F	2	70	78	7	11.5	4	6.5	9.5	15	5	3	2	2	5	5	2	5	5	5	26	26	27	26	27
25	reshma	26	50	F	1	62	70	3	5	2	4	4.5	9	4	2	3	3	3	5	4	5	5	5	26	25	26	26	27
26	lakshmi	48	68	F	2	40	47	11	17	6	10	15	18.5	2	2	3	4	4	5	2	5	5	5	26	25	26	26	27
27	valarmathi	42	64	F	1	45	52	6.6	10	3	6	8	13	3	2	2	3	5	4	3	4	5	5	27	26	27	28	28
28	neelaveni	39	60	F	1	67	75	5	8	3	6	7.5	11	4	2	3	4	4	5	3	4	5	5	26	25	27	28	28
29	banumathy	38	58	F	1	55	63	5	9	3	5	7.5	11	3	2	2	3	5	5	3	4	5	5	26	26	27	28	28
30	nila	43	60	F	2	60	67	16	13.5	6.5	10	11	16	4	2	3	4	6	5	2	5	5	5	26	26	26	27	27

Medium flow group

S.No.	Patient name	age	weight	sex	asa	surgery time	anaesthesia time	eye opening	Squeeze fingers	Spontaneous breathing	Extubation	State name	recovery time(>9)	VAS Base line	1 hr	3hrs	6hrs	24 hrs	SEDATION Base line	1 hr	3 hr	6hrs	24 hrs	MMSE Base line	1 HR	3 HRS	6 HRS	24 HRS
1	pandiyammal	47	F	68	2	60	68	5	7.5	3	5.5	8	11	4	2	3	4	6	5	2	4	5	5	27	26	27	28	28
2	lakshmi	50	F	65	2	75	83	7.5	10	4.5	7	12	13	4	2	3	4	5	5	3	4	5	5	27	26	27	27	27
3	fathima	36	F	70	1	55	65	6.6	8	3.5	6	8.5	10	3	2	3	4	4	5	3	4	5	5	28	27	27	28	28
4	farhana	39	F	60	1	58	65	7	9.5	4.5	5.5	9	13	4	2	2	3	6	5	2	4	5	5	26	25	26	26	27
5	swamy	30	M	58	1	65	74	4.5	6.5	2	5	8	9	5	3	3	3	5	5	2	4	5	5	25	22	23	24	25
6	ansari	29	M	62	1	70	78	9.5	12	5	10	11	15	4	1	3	3	5	5	4	4	5	5	28	26	27	28	28
7	muniyammal	49	F	68	2	67	75	10	14	5.5	8	13	15	4	2	3	3	4	5	4	4	5	5	27	27	27	27	28
8	sathya	41	F	70	2	60	67	6.5	10	4	6	9.5	12	4	2	3	4	5	5	3	5	5	5	27	26	27	28	28
9	muthu	35	M	63	1	45	54	6	8.5	4	5.5	7	13	4	2	2	3	6	5	3	5	5	5	26	25	26	26	27
10	lakshmiammal	58	F	65	2	70	77	17	20	6.5	14	18	23	5	2	3	3	5	5	2	5	5	5	26	24	26	26	26
11	manoharan	45	M	55	1	50	57	6	8.5	3.5	6.5	8	13	4	1	2	3	5	5	3	4	5	5	27	26	27	27	28
12	adhitya	37	M	60	1	85	92	7.5	9	4	7	8.5	13	3	2	2	4	5	5	2	5	5	5	27	25	27	28	28
13	palani	50	M	65	2	75	83	15	17	7.5	15	18	20	4	2	2	3	4	5	3	4	5	5	27	26	27	27	28
14	anbarasan	29	M	58	1	55	63	4	6.5	2	4.5	5	9	4	2	2	3	4	5	4	4	5	5	27	26	26	27	27
15	dhanam	42	F	60	2	50	58	6.5	9	3	6	8.5	12	5	2	2	3	6	5	3	4	5	5	27	25	26	27	27
16	elavarasi	36	F	68	1	66	73	5.5	8	2	6	8	10	3	3	2	3	4	4	4	5	5	5	26	25	26	26	27
17	jothy	32	F	70	1	65	73	7.5	9	4.5	6	8.5	13	2	3	3	3	5	4	3	4	5	5	28	26	28	28	18

18	janaki	34	F	65	1	68	75	6.5	9	3	5.5	8	12	5	3	3	3	3	5	4	5	5	5	27	26	27	28	28
19	muneeswaran	44	M	50	2	56	65	8.5	12	5.5	9.5	10	14	3	2	3	4	5	5	3	4	4	5	27	26	27	27	28
20	dhivya	33	F	55	1	55	63	6	7	3.5	6.5	6.5	12	3	2	3	4	6	5	2	4	5	5	27	26	27	28	28
21	kumar	55	M	60	2	45	52	16	20	8.5	15	18	22	4	2	3	4	5	5	2	4	5	5	25	21	23	25	25
22	kumari	38	F	62	1	60	68	7.5	9	4	6.5	8.5	12	3	3	2	3	6	5	3	4	5	6	27	26	27	27	28
23	lakshmi	30	F	58	1	78	85	5	8	3.5	4.5	8	11	4	3	2	3	5	5	3	4	5	5	28	26	28	28	28
24	gandhiammal	42	F	67	2	85	93	9	13	4.5	7.5	10	15	3	2	2	3	5	4	3	4	5	5	27	26	27	27	28
25	dhamodaran	40	M	50	1	40	48	8.5	11	4	9	10	14	4	3	2	3	6	4	2	4	5	5	27	26	27	27	28
26	hari	52	M	60	2	65	73	18	20	10	16	18	22	5	4	3	3	4	4	3	4	4	4	26	25	26	26	27
27	karthika	48	F	65	2	55	65	11	14	5	9	15	17	4	2	3	5	5	5	4	5	5	5	27	26	26	27	27
28	muthulakshmi	35	F	72	1	60	70	7.5	10	4.5	8	9.5	14	4	3	3	4	6	5	2	3	5	5	26	25	25	26	27
29	jeyaram	46	M	60	2	75	83	8	12	4.5	8.5	10	14	3	3	3	3	5	5	3	4	5	5	27	25	26	27	27
30	muthuveeran	34	M	55	1	50	58	6	9	3.5	5.5	8.5	14	4	3	2	4	5	5	4	5	5	5	26	25	26	27	27

Low flow group - hemodynamics

S.No.	Patient Name	sex	pulse rate							MAP							spo2							fio2							etco2						
			5min	15min	30min	45min	60min	75min	90min	5min	15min	30min	45 min	60min	75min	90min	5min	15min	30min	45min	60min	75min	90min	5min	15min	30min	45min	60min	75min	90min	5min	15min	30 min	45min	60min		
1	dhanam	F	96	88	80	78	95			105	95	90	93	90			99	99	99	99	99			54	47	46	44	45			30	35	35	35	38		
2	pandeeswari	F	102	110	80	89	88			110	120	113	99	88			99	98	99	99	99			53	44	43	45	45			31	34	36	36	35		
3	banu	F	98	90	85	88	75			110	95	90	92	88			99	99	99	99	99			56	45	44	46	44			32	34	34	34	35		
4	anushree	F	90	85	87	84	88			102	90	88	90	94			99	99	99	99	99			52	44	45	43	43			31	34	34	34	34		
5	arumugam	M	112	98	90	78	70			114	120	110	92	96			99	99	99	99	99			51	46	43	44				31	35	35	34			
6	sooriyan	M	97	99	70	84	86			105	100	89	90	98			99	99	99	99	99			50	44	42	45	44			31	35	35	35	34		
7	sita	F	90	82	80	78	70			110	90	88	93	98			98	99	99	99	99			49	43	46	43	89			30	35	36	36	34		
8	ramarajan	M	89	70	75	76	70			108	95	90	93	90			99	99	99	99	99			51	46	45	46	45			29	36	35	33	35		
9	mohan	M	104	94	90	87	86			110	90	89	90	86			99	99	99	99	99			53	47	44	47	46			30	34	34	34	33		
10	gandhi	M	98	90	88	90	85	98	104	104	115	87	90	94	102	95	100	99	99	99	99	99	100	52	44	45	43	43	50		32	35	35	34	35		

11	marimuthy	M	107	100	88	100				98	90	88	90	95			99	100	99	99	99			56	43	46	45				33	34	35	34	41		
12	raasu	F	80	78	75	80	83			100	88	90	93	88			99	99	99	99	99			62	45	43	44	42			31	33	35	35	33		
13	devi	F	99	90	98	78	76			115	110	108	94	89			99	99	99	99	99			54	46	45	45	44			32	34	35	36	34		
14	dhanya	F	89	80	88	80	84			105	95	96	90	83			100	98	99	99	99			53	47	45	43	45			32	35	34	33	34		
15	sriram	M	105	94	90	84	78			98	90	89	90	90			98	99	99	98	99			51	43	46	46	45			32	34	34	34	34		
16	maheshwari	F	90	86	85	80	98			100	85	90	93	93			99	99	100	100	99			50	44	47	43				31	35	35	34			
17	maareswaran	M	79	75	70	103	78			102	90	88	90	98			99	99	99	99	99			49	44	43	45				34	34	35	41			
18	mukunth	M	92	89	80	85	98	95		105	95	90	93	102	98		99	99	99	99	99	98		51	42	44	46	44			35	34	34	35	36		
19	aruljothy	F	113	102	90	89	80	102		110	93	90	90	97	110		99	99	99	99	99	100		53	45	43	43	43			34	35	35	35	34		
20	sathyajothy	F	82	78	70	78	70	89	95	105	91	89	90	87	94	102	99	99	99	99	99	99	100	53	46	42	42	45	90		32	36	34	35	35		
21	sahayamary	F	94	84	80	98	72			110	90	90	93	93			99	99	99	99	99			55	44	46	45				34	34	35	36			
22	joseph	M	100	88	85	97	75			112	95	90	95	90			99	99	99	99	99			49	46	47	43				35	35	33	35			
23	sekar	M	88	80	75	70	102	98		105	90	92	90	105	96		99	99	99	99	99	99		48	42	43	44	43			32	34	35	32	34		
24	rekha	F	93	87	80	85	90	112	98	100	90	90	94	87	110	95	99	99	99	99	98	99	98	52	43	45	44	42			32	34	34	34	33		
25	reshma	F	74	70	74	70	102	97		95	88	88	90	90	110		99	99	98	99	100	99		53	44	44	45	43			34	34	35	33	35		
26	lakshmi	F	97	95	84	102				108	110	105	93	112			99	99	99	99	99			54	45	43	43	43			34	35	35	34	40		
27	valarmathi	F	95	84	80	109	81			102	90	92	90	110			99	98	99	99	99			51	44	45	43	45			33	34	35	35	36		
28	neelaveni	F	102	83	98	90	78			100	85	90	87	90			99	100	99	99	99			50	46	46	45	43	89		32	34	34	33	35		
29	banumathy	F	80	83	86	88	97	94		102	90	90	88	102	93		99	99	99	100	99	99		49	48	46	44	45			32	35	34	35	38		
30	nila	F	102	87	88	85	102	94		110	100	95	90	108	98		99	99	99	99	99	99		52	43	43	43	44			31	34	35	34	36		

Medium flow group - hemodynamics

S.No.	Patient Name	sex	pulse rate							MAP							spo2							fio2							etco2						
			5min	15min	30min	45min	60min	75min	90min	5min	15min	30min	45 min	60min	75min	90min	5min	15min	30min	45min	60min	75min	90min	5min	15min	30min	45min	60min	75min	90min	5min	15min	30 min	45min	60min	75min	90min
1	pandiyammal	F	102	90	84	80	76			112	98	97	90	88			99	99	99	99	99			50	43	44	45	45			30	34	36	33	34		
2	lakshmi	F	111	93	90	91	89	85	90	112	113	98	92	88	90	94	100	99	99	99	99	99	99	53	44	45	46	46	47		31	35	35	34	34		

3	fathima	F	103	89	78	70	73	90		115	105	100	95	90	100		98	99	99	99	99	99		54	45	46	46	42			32	33	34	32	35		
4	farhana	F	98	88	70	65	68	88		101	98	90	87	89	99		99	99	99	99	99	99		52	45	44	43	42			33	34	33	33	33		
5	swamy	M	90	78	70	73	70	103	89	102	96	90	88	88	112		99	99	99	98	99	99		51	46	45	45	43	88		31	35	35	34	33		
6	ansari	M	110	98	90	89	83	100	78	99	90	89	90	91	98		99	99	99	99	99	99		49	43	42	46	44	50		33	36	34	32	32		
7	muniyammal	F	112	110	98	80	78	103	89	119	124	115	102	93	110	99	99	98	99	99	99	99	99	54	42	44	44	46	54		34	34	33	33	33		
8	sathya	F	103	89	83	80	83	89		112	100	98	89	89	96		99	99	99	99	100	99		55	47	46	44	45			31	33	33	32	35		
9	muthu	M	98	80	82	80	89			115	98	94	86	88			99	99	99	99	99			55	47	43	45				30	32	32	33			
10	lakshmiammal	F	107	102	100	95	87	98		118	120	110	90	93	108	98	99	99	98	99	99	99	99	52	46	42	44	46	56		29	35	34	34	32	37	
11	manoharan	M	99	90	93	90	104	80		104	97	98	92	108	95		99	99	99	100	99	99		51	45	45	46	85			32	36	33	33	39		
12	adhitya	M	98	90	84	80	73	78	102	105	96	98	92	90	95	103	99	99	99	99	99	99	99	55	47	44	42	42	45	58	31	34	35	32	34	34	40
13	palani	M	102	98	93	90	83	89		110	102	96	90	104	98	102	99	99	99	99	99	99	99	55	42	44	43	44	45		32	33	33	29	34	38	
14	anbarasan	M	112	80	78	70	93	90		115	98	93	90	102			99	98	99	99	99			53	43	42	44	44			33	34	32	33	36		
15	dhanam	F	102	90	80	78	102	90		103	97	94	86	106	98		99	99	99	99	99	99		55	44	44	45	80			34	35	34	32	39		
16	elavarasi	F	108	85	80	75	83	98		105	92	90	84	90	103	98	99	100	99	99	99	99	99	54	44	42	44	44	89		31	34	34	35	34	40	
17	jothy	F	112	85	88	80	84	95	90	109	90	90	88	89	102		99	99	99	99	99	99		52	45	41	45	45	87		34	35	33	36	33	39	
18	janaki	F	98	90	93	90	84	104	88	104	92	97	90	94	110	98	99	99	99	99	99	99	99	52	44	44	44	43	80		35	33	31	34	34	38	
19	muneeswaran	M	110	101	90	89	83	90		119	113	98	89	94	98		99	99	99	99	99	99		50	43	46	43	44			30	31	34	33	34		
20	dhivya	F	109	85	90	84	80	98		104	98	99	90	101	97		99	99	99	99	99	99		53	45	45	44	45			32	33	33	34	38		
21	kumar	M	113	102	93	83	80			124	120	115	92	98			99	99	99	99	99	98		52	46	46	42	90			33	32	34	34	43		
22	kumari	F	112	98	89	86	80	90		102	96	90	90	88	98		99	99	99	99	99			55	45	46	42	44	90		32	34	34	33	34	43	
23	lakshmi	F	107	89	80	83	87	88	98	98	90	93	89	93	97	94	99	99	99	99	99	99		56	44	47	44	44	45	90	30	33	33	32	33	34	40
24	gandhiammal	F	114	90	78	70	76	89		103	93	90	88	99	100	92	99	99	100	99	99	100	99	52	42	44	46	42	90		34	34	34	33	33	42	
25	dhamodaran	M	108	94	89	100	89			103	94	96	105	94			99	99	99	99	99			54	45	44	44	44			35	33	32	34	32		
26	hari	M	102	98	102	100	90	104	88	115	116	102	90	96	102	98	100	99	99	99	99	99	99	53	44	43	45	46	88		34	30	33	33	31	39	
27	karthika	F	112	93	90	83	100	90		110	98	90	86	98	98		99	99	99	99	99	99		50	45	45	44	46			33	34	34	33	31		
28	muthulakshmi	F	104	87	80	78	72	90		104	90	91	89	95	99		99	99	99	99	99	99		49	46	46	42	43	92		31	33	35	32	32	43	
29	jeyaram	M	103	93	87	80	78	78	88	110	102	89	88	98	98	98	99	99	99	99	99	98	99	48	44	44	42	45	46	90	33	34	34	34	33	35	43
30	muthuveeran	M	92	82	80	78	103	90		98	90	92	88	106			99	99	99	99	99			55	43	46	45	44	88		32	31	32	34	33		

Ref. No. 68/E4/2/2014

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Madurai.20. Dated: 02.2014

Institutional Review Board / Independent Ethics Committee.
Captian. Dr. B. Santhakumar, M.D., (F.M.,)
Dean, Madurai Medical College &
Govt Rajaji Hospital, Madurai 625020. **Convenor**

Sub: Establishment-Govt. Rajaji Hospital, Madurai-20-
Ethics committee-Meeting Minutes- for January 2014
Approved list -regarding.

The Ethics Committee meeting of the Govt. Rajaji Hospital, Madurai was held on 20.1.2014, Monday at 10.00 am to 12.00.noon at the Anaesthesia Seminar Hall, Govt. Rajaji Hospital, Madurai. The following members of the committee have attended the meeting.

1.Dr. V. Nagarajan, M.D., D.M (Neuro) Ph: 0452-2629629 Cell.No 9843052029	Professor of Neurology (Retired) D.No.72, Vakkil New Street, Simmakkal, Madurai -1	Chairman
2. Dr.Mohan Prasad , M.S M.Ch Cell.No.9843050822 (Oncology)	Professor & H.O.D of Surgical Oncology(Retired) D.No.72, West Avani Moola Street, Madurai -1	Member Secretary
3. Dr. Parameswari M.D (Pharmacology) Cell.No.9994026056	Director of Pharmacology Madurai Medical College	Member
4. Dr.S. Vadivel Murugan, MD., (Gen.Medicine) Cell.No 9566543048	Professor of Medicine Madurai Medical College	Member
5. Dr.S. Meenakshi Sundaram, MS (Gen.Surgery) Cell.No 9842138031	Professor & H.O.D of Surgery Madurai Medical College	Member
6. Mrs. Mercy Immaculate Rubalatha, M.A., Med., Cell. No. 9367792650	50/5, Corporation Officer's quarters, Gandhi Museum Road, Thamukam, Madurai-20	Member
7. Thiru.Pala. Ramasamy , BA.,B.L., Cell.No 9842165127	Advocate, D.No.72.Palam Station Road, Sellur, Madurai -2	Member
8. Thiru. P.K.M. Chelliah ,B.A Cell.No 9894349599	Businessman, 21 Jawahar Street, Gandhi Nagar, Madurai-20	Member

The following Project was approved by the committee

..2..

Name of P.G.	Course	Name of the Project	Remarks
Dr. R. Arun	PG in M.D., (Anaesthesiology) Madurai Medical College and Government Rajaji Hospital, Madurai.	Cognitive function and recovery after sevoflurane anaesthesia: A comparison of low-flow and medium-flow anaesthesia	Approved

Please note that the investigator should adhere the following: She/He should get a detailed informed consent from the patients/participants and maintain it Confidentially.

1. She/He should carry out the work without detrimental to regular activities as well as without extra expenditure to the institution or to Government.
2. She/He should inform the institution Ethical Committee, in case of any change of study procedure, site and investigation or guide.
3. She/He should not deviate the area of the work for which applied for Ethical clearance. She/He should inform the IEC immediately, in case of any adverse events or Serious adverse reactions.
4. She/He should abide to the rules and regulations of the institution.
5. She/He should complete the work within the specific period and if any Extension of time is required He/She should apply for permission again and do the work.
6. She/He should submit the summary of the work to the Ethical Committee on Completion of the work.
7. She/He should not claim any funds from the institution while doing the work or on completion.
8. She/He should understand that the members of IEC have the right to monitor the work with prior intimation.

Member Secretary **Chairman**
Ethical Committee

26.2.14
DEAN/Convenor
Govt. Rajaji Hospital,
Madurai- 20.

6/2/14

To
The above Applicant
-thro. Head of the Department concerned

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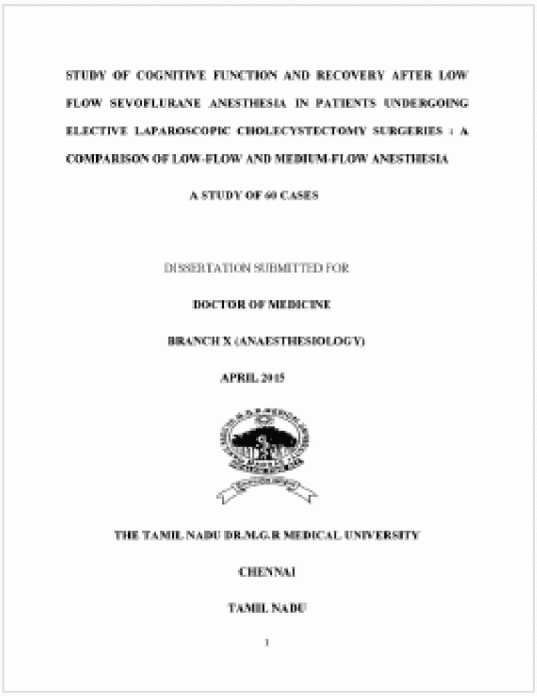

STUDY OF COGNITIVE FUNCTION AND RECOVERY AFTER LOW FLOW SEVOFLURANE ANESTHESIA IN PATIENTS UNDERGOING ELECTIVE LAPAROSCOPIC CHOLECYSTECTOMY SURGERIES : A COMPARISON OF LOW-FLOW AND MEDIUM-FLOW ANESTHESIA

A STUDY OF 60 CASES

DISSERTATION SUBMITTED FOR

DOCTOR OF MEDICINE

BRANCH X (ANAESTHESIOLOGY)

APRIL 2015

THE TAMIL NADU DR.M.G.R MEDICAL UNIVERSITY

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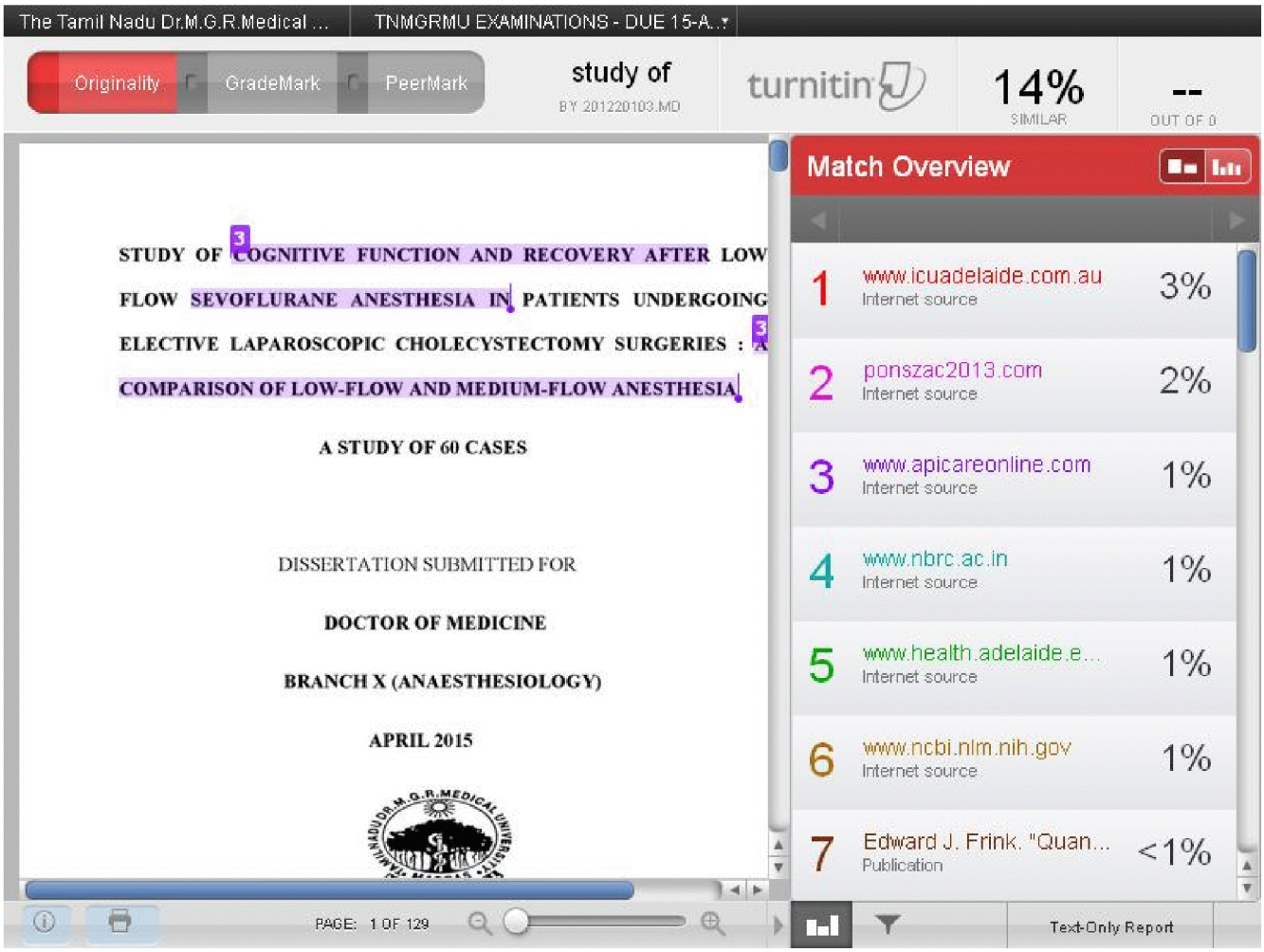
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